



Grand Junction Rail-with-Trail

Feasibility Study

October 2006
City of Cambridge, Massachusetts

alta
PLANNING + DESIGN

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EXECUTIVE SUMMARY

The Grand Junction Rail-with-Trail Feasibility Study examines the potential alignments for creating a non-motorized trail along a historic rail corridor in Cambridge, Massachusetts while maintaining the current rail operations and accommodating proposed Urban Ring transit facilities. The purpose of this study is to build upon earlier studies and provide the preliminary foundation needed to plan, design, and construct the trail. This study examines the benefits of the project, summarizes the existing conditions along the corridor, describes and evaluates alignment options, provides information regarding design and phasing of the trail, and touches upon management of the trail corridor.

The use of the Grand Junction corridor as a linear path was envisioned by the 2000 Cambridge Green Ribbon Open Space Committee in its study of possible new parks and open space in the city and was identified as a top priority. The 2001 Eastern Cambridge Planning Study (ECAPS) also recommended the creation of the path along the Grand Junction corridor as an infrastructure project to enhance non-auto mobility. These two processes identified the opportunity for creating a linear open space in the neighborhoods' extensive new development in Eastern Cambridge, through which the railroad corridor passes, as a major benefit of creating a trail, since these areas do not currently have extensive open space opportunities.

The Grand Junction Rail-with-Trail (RWT) would create a major north-south bicycle and pedestrian linkage between Boston, the MIT campus, several dense Cambridge neighborhoods and Somerville. By providing a vital urban component to the existing network of parkland-based trails, the trail would do much to encourage bicycling and walking to and from the area's major employment and university centers.

The Grand Junction RWT would also serve to highlight portions of Cambridge's industrial history by providing new public access to the old rail corridor. The trail's route from parklands, through the old manufacturing corridor, to residential neighborhoods – all in only two miles – would provide an interesting and unique experience to trail users.

Trail Alignment and Design Features

- The trail alignment would follow the right-of-way of the historic rail corridor. There are two potential options, one which incorporates the latest plans for the Urban Ring, and the other which could happen should the Urban Ring not be developed on the surface along the Grand Junction. Without the Urban Ring, the trail would be aligned along primarily along the western edge of the corridor, with some sections on the east. Where the Urban Ring is proposed for the surface, the preferred cross-section within the corridor has the trail on the western most edge, the Bus Rapid Transit in the middle, and the existing rail line to the east.
- A 12-foot-wide (optimum width) trail with an asphalt surface and soft shoulders would accommodate a wide variety of non-motorized uses including pedestrian, recreational and commuting bicyclists, wheelchairs, in-line skaters and others. In constricted areas, the trail may need to narrow to 10 feet wide.
- Development of potential trailheads and pedestrian access points would provide good access for local and region-wide trail users.
- The trail would provide connections to community facilities and neighborhoods.
- Intersection improvements would ensure safe trail crossings at existing roads.
- Directional and regulatory signage would help orient trail users and inform them about trail etiquette.
- Safety and security features include lighting and good definition between the trail and adjacent neighbors.
- Design features would maximize the trail's aesthetic and functional qualities.

Next Steps

1. Work with property owners to ensure that new development does not preclude the future creation of the trail.

2. Pursue the creation of a Pathway Overlay District along the Grand Junction corridor to protect the future use of the corridor as a multi-use path.

3. Participate in the Urban Ring planning process to ensure that proposed alignments permit the creation of the trail.

4. Work with CSX and MIT to create strategies for ensuring that their operational needs are met in the planning of a trail.

5. Investigate funding opportunities for creating the path, in a phased approach, or as a whole should an opportunity become available.

1. INTRODUCTION

The two-mile long Grand Junction Railroad right-of-way through eastern Cambridge presents a unique opportunity to develop a "rail-with-trail"[1] (RWT) while maintaining current rail operations and accommodating proposed Urban Ring[2] transit facilities.

This report studies the feasibility of a RWT for the Grand Junction corridor. It includes an analysis of existing conditions, evaluation of two design options, a liability and insurance plan, and an implementation strategy.

Project Background and Significance

The proposed Grand Junction RWT would serve bicyclists, pedestrians, joggers, in-line skaters and others as a recreational and transportation route, linking various Cambridge neighborhoods and serving major employment and university centers.

The use of the Grand Junction corridor as a linear path was envisioned by the Cambridge Green Ribbon Open Space Committee[3] in its study of possible new parks and open space in the city and was identified as a top priority. The 2001 Eastern Cambridge Planning Study (ECAPS) also recommended the creation of the path along the Grand Junction corridor as an infrastructure project to enhance non-auto mobility. These two processes identified the opportunity for creating a linear open space in the neighborhoods' extensive new development in Eastern Cambridge, through which the railroad corridor passes, as a major benefit of creating a trail, since these areas do not currently have extensive open space opportunities.

The Grand Junction RWT would create a major north-south bicycle and pedestrian linkage between Boston, the MIT campus, several dense Cambridge neighborhoods and Somerville. By providing a

[1] A rail-with-trail is a trail immediately adjacent to an active rail line, as opposed to a rail-to-trail, which would replace an abandoned railroad line with a trail.
[2] The Urban Ring is an MBTA project to improve the circumferential connections among the spokes of the T's many radial lines. The project corridor passes through Boston, Chelsea, Everett, Medford, Somerville, Cambridge, and Brookline.
[3] See "Report of the Green Ribbon Open Space Committee," March 2000, by the Cambridge Community Development Department.

vital urban component to the existing network of parkland-based trails, the trail would do much to encourage bicycling and walking to and from the area's major employment and university centers.

The Grand Junction RWT would also serve to highlight portions of Cambridge's industrial history by providing new public access to the old rail corridor. The trail's route from parklands, through the old manufacturing corridor, to residential neighborhoods – all in only two miles – would provide an interesting and unique experience to trail users.

Project Location

The corridor runs through the neighborhoods of East Cambridge, Area Four, and Cambridgeport. (See Figure 1-1). Major employment centers such as Kendall Square/Cambridge Center and the Massachusetts Institute of Technology (MIT) lie immediately adjacent to the corridor. The corridor runs southwest to northeast across eastern Cambridge, crossing from Boston (Allston) over the Charles River and running parallel to Vassar Street and Fulkerson Street to Gore Street, where it enters Somerville. The Dr. Paul Dudley White Bike Path already exists at its southern end along the Charles River basin. At its northern end it connects to parklands in North Point via the street network, although there is potential for developing a direct connection to the proposed Somerville Community Path in the future.

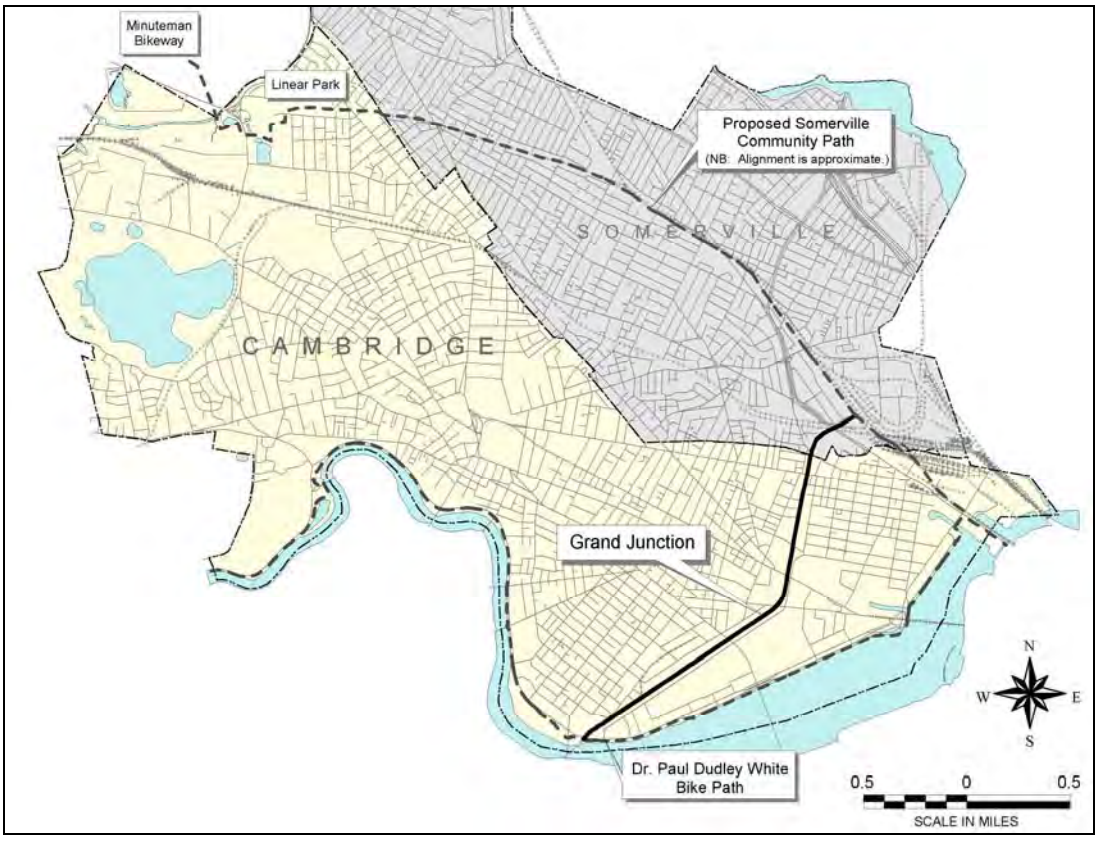


Figure 1-1. Vicinity Map

Project Benefits

The proposed Grand Junction Multi-Use Trail would provide recreational benefits and transportation choices for Cambridge residents, workers, students, and visitors. The path[4] would serve areas of Cambridge that have limited trail access. The densely populated neighborhoods of Cambridgeport, Area Four, and East Cambridge contain approximately 34% of the City's population. The Green Ribbon Report identified the eastern part of the city as one with high need and priority for creating a trail.

Following are some of the benefits of the Grand Junction Trail:

- Open space and recreational facility for Cambridge neighborhoods
- Strong linear park connection to Charles River Basin
- Transportation route for Cambridge residents, workers, visitors
- Link in regional network of multi-use paths
- Pedestrian path linking Urban Ring stations and Cambridge destinations

Connections to Regional Pathways

The Grand Junction Multi-Use Trail would add a major link in the growing regional system of bicycle and multi-use pathways. As Figure 1-2 shows, the path would connect Boston, the Charles River paths, Cambridgeport, East Cambridge, and Somerville. The connections with the Charles River paths would facilitate bike travel to and from Watertown, Newton, Allston/Brighton, Back Bay/Fenway, Beacon Hill, and Charlestown. Via a short connection in Boston, the Grand Junction Trail would also connect to the "Emerald Necklace" system of paths through the Fenway, Roxbury, Jamaica Plain and Forest Hills sections of Boston.

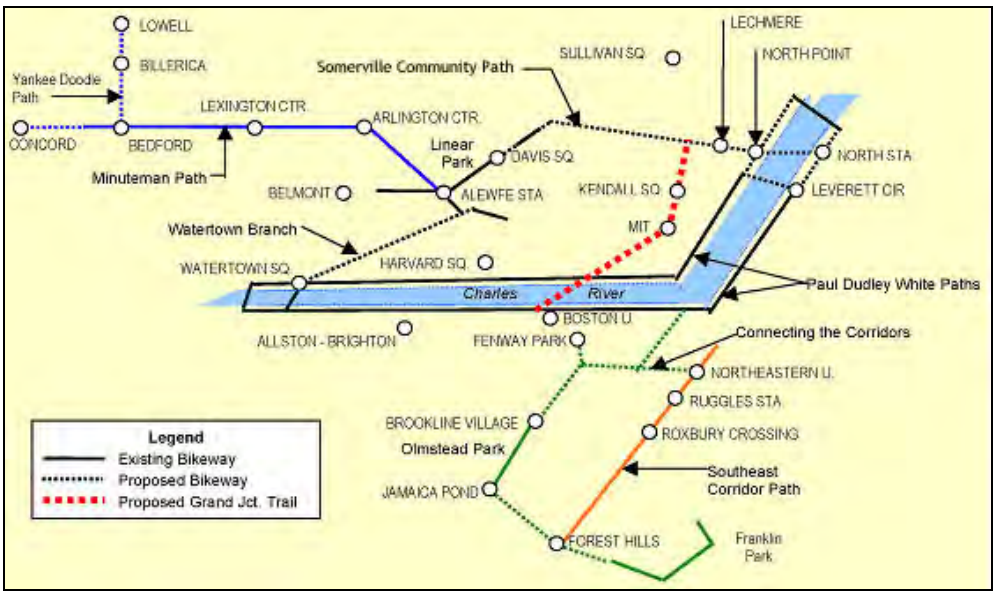


Figure 1-2. Regional Bikeways and Pathways

[4] The terms "trail" and "path" are used interchangeably in this document.

The path also intersects on-street bicycle lanes along Massachusetts Avenue, Main Street and Hampshire Street. These routes facilitate bike travel to and from Arlington, Boston, Somerville, and from within Cambridge.

With the proposed extension in Somerville of the Linear Park bikeway (Somerville Community Path), the Grand Junction Trail would also connect with the Minuteman Path to Arlington, Belmont, Lexington, and Bedford. Proposals also exist for a path from the end of Minuteman in Bedford west to Concord along an abandoned railbed.

The Grand Junction Trail would have direct connections to the Charles Basin pathways (Dr. Paul Dudley White Path) on either side of the river. These paths currently extend from the Museum of Science to beyond Watertown Square. There are plans underway to extend the Charles River pathways on each side of the river beyond the Museum of Science to the Charlestown Bridge (North Washington Street). A portion of this path system in North Point Park is under construction and expected to be completed in 2006.

Another proposal is the use of the Watertown Branch railbed from the vicinity of Fresh Pond to Watertown Square, and a connection to the Charles River pathways.

The Charles River Basin pathways come within one-half mile of the "Emerald Necklace" bike path system. This system includes existing pathways along the Riverway, Olmstead Park, the Arboretum, and Franklin Park; as well as the Southwest Corridor bike path. Under the proposed restoration of the Emerald Necklace by Boston Parks and Recreation and the Town of Brookline, bike paths will be continuous from the Back Bay to Franklin Park. Included is a connection between the Back Bay Fens and the Southeast Corridor path via Forsyth Street and the Northeastern University campus (a project know as "Connecting the Corridors").

Overall, the Grand Junction Trail would be a component in a system of well over 50 miles of contiguous pathways in Greater Boston.

Open Space Recreational Resource

Cambridge is a dense, highly developed city with little untapped open space. The Grand Junction corridor represents one of the best remaining opportunities for new open space for active recreation. As noted in the City's Green Ribbon Committee report, "Park trails, pathways and 'linear parks' serve several key functions – as an alternative for car-free commuters, as a vital form of safe, enjoyable access to community parks and large urban parks, and as a pleasure in themselves. Improving or creating several park trail connections would enhance all of these functions for Cambridge."

The Grand Junction Trail would serve areas of Cambridge with limited open space resources. In addition to being an important recreational resource itself, the path would connect Area Four, East Cambridge, and Cambridgeport with the Charles River Basin reservation at Magazine Beach. The basin is the largest open space in the city and defines nearly one-half of the perimeter of Cambridge. Magazine Beach includes recreation fields, a swimming pool, and pathways along the river, including the Paul Dudley White Bike Path. Unfortunately, much of Cambridge is either distant from the riverfront or the route to the Charles is difficult or indirect. The Charles River Basin will be more accessible to city residents, especially young children, the elderly, and those with disabilities by using a path that is safe, level, and has few street crossings.

Trip Mitigation

The Grand Junction Multi-Use Trail would make commuting by bicycle or on foot easier and more attractive for a large number of commuters. In 1999, over 56,000 people worked within one-half mile of the corridor.[5] This number is only increasing with the expansion of office space and R&D facilities.

The path would make commuting and other utilitarian trips by bicycle and transit more convenient for many who live in Cambridge and the surrounding communities. Reducing motor vehicle traffic is a priority for the City of Cambridge. Increasingly, residents see growing motor vehicle traffic as a major issue, affecting their health and the livability of their neighborhoods. The path and the Urban Ring would be important contributions encouraging people to leave their cars at home.

Bicycle Transportation

As Figure 1-2 on page 1-3 shows, the path would facilitate bicycle travel between Cambridge and Boston, Somerville, Watertown, Newton, Allston/Brighton, Arlington, and other nearby communities.

Pedestrian and Transit Trips

As a walking path, it would augment the proposed Urban Ring transit line by distributing riders to destinations between proposed stations.

Other Benefits

The presence of the path would benefit emergency services, by providing a paved access route that could be used by police, fire, and ambulance. The construction of a path would improve the aesthetics of the corridor and potentially increase property values of land adjacent to the path. This would enhance areas such as the MIT campus, the Kendall Square/Cambridge Center area and residential areas in East Cambridge. The path would tie together adjacent communities by making walking and bicycling trips easier and more seamless.

[5] Cambridge Community Development Department, November 1999.

Other Proposed Uses: Urban Ring

– **Urban Ring**: The Urban Ring is a Massachusetts Bay Transportation Authority (MBTA) project in the concept stage. The Urban Ring study is considering a combination of fixed-route transit with bus route improvements to meet increasing demand for crosstown travel. It includes East Boston, Chelsea, Everett, Somerville, Cambridge, plus the Kenmore/Fenway, Roxbury, and Columbia Point sections of Boston.

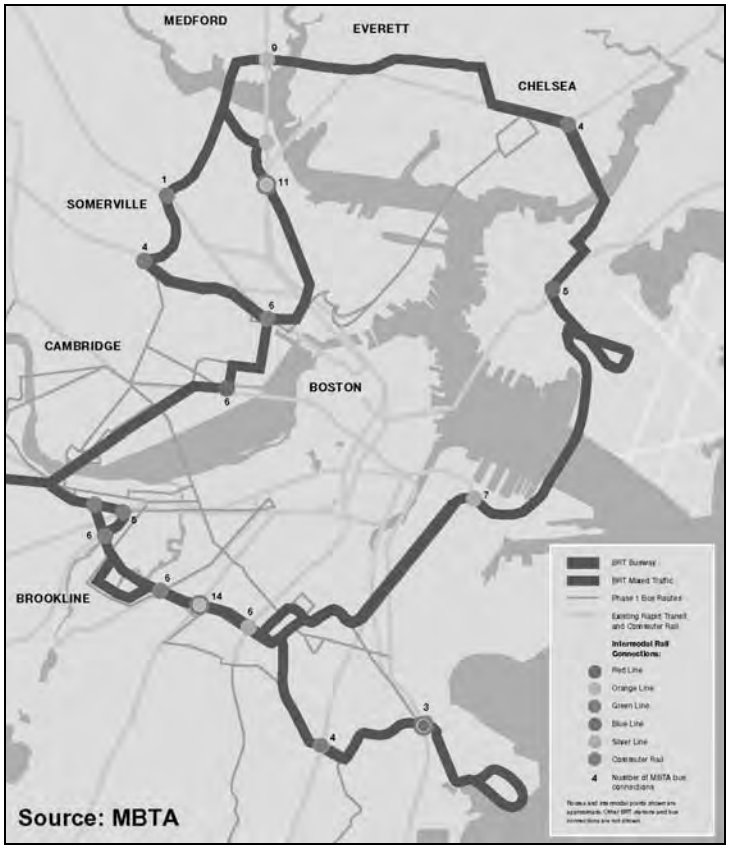


Figure 1-3. Urban Ring Project

Due to the importance of the Urban Ring project, consultants analyzed several alternatives that included shared corridor use with the proposed RWT, as explained in Section 3: Alternative Alignments. Any consideration of a trail along the Grand Junction corridor must include the possible Urban Ring alternatives.

The current proposal (analyzed for this report) for the next phase of the Urban Ring is a bus rapid transit at-grade alternative that would be a one-way northbound at-grade busway entering the Grand Junction right-of-way in lower Cambridgeport and continuing to Main Street, where it turns onto the street. The southbound bus would operate on Albany Street. In late 2005, it was determined that a new process be undertaken to re-evaluate options for the Urban Ring, which is beginning in 2006. This could change again what may happen along the Grand Junction corridor but it is anticipated that the new study will take the multi-use path into account.

Background Documents

This report draws heavily on a proposal written by the Cambridge Bicycle Committee (*Grand Junction Multi-Use-Path: A Proposal*, Final Draft August 2001). It also draws on the U.S. Department of Transportation's *Rails-with-Trails: Lessons Learned* report (August 2002), which presents case studies on 21 RWT projects and covers best practices in planning, liability reduction, design, and corridor management, among numerous other issues.

In addition, the following documents have served as references:

- Cambridge Pedestrian Plan
- Cambridge Bicycle Plan (Draft)
- Cambridge Growth Policy Document, *Towards a Sustainable Future*
- Green Ribbon Committee Report
- Eastern Cambridge Planning Study (ECAPS)

Project Process

The process for this project encompassed technical research, numerous meetings, and field review. It included the following steps:

- Research on corridor ownership.
- Field review of the corridor.
- Analysis of legal issues.
- Site walk with representatives of city bicycle and pedestrian committees, city departments and MIT.
- Meetings with the project working group (see acknowledgements).
- Meetings or conversations with:
  - MIT Department of Facilities personnel
  - MBTA officials and EarthTech (their consultants for the Urban Ring project)
  - CSX railroad personnel
  - Cambridge Redevelopment Authority
  - Cambridge Bicycle Committee
  - Cambridge Pedestrian Committee
  - Area 4 Neighborhood Association
  - East Cambridge Planning Team
  - Cambridge residents through an open house meeting

2. EXISTING CONDITIONS

This chapter reviews the history of the project area, adjacent land uses, property ownership, current and proposed rail operations, and existing safety conditions.

History

The Grand Junction Railroad was one of the first north-south rail links in the Boston metropolitan area. Opened in 1855 by the Grand Junction & Depot Company, the line followed a serpentine alignment weaving through the newly industrialized areas of Cambridgeport, East Cambridge, Charlestown, Everett and Chelsea, ending at the piers of East Boston.

MIT in 1901

In the latter half of the 19th century, Cambridge had an extensive network of spurs, sidings and street trackage serving warehouses and factories. The main line included as many as four or five tracks in places, while the spurs and street trackage branched out to locations several blocks from the main line. Several firms provided a significant source of freight revenue, including: Boston Woven Hose and Rubber Co. (rubber goods, hose, tires, and belts; at the current "One Kendall Square"); North Packing & Provision Co. (meats); John Reardon & Sons (soap); and Norcross Bros. (stone cutters).

The Grand Junction RR initially also provided freight connections between the south side Boston & Worcester RR and the four north side lines that were eventually merged into the Boston & Maine RR. The Boston & Worcester RR became the Boston & Albany RR (B&A), and the Grand Junction RR itself was bought by the B&A in 1869. By 1900, the B&A was purchased and operated by its new parent company, the New York Central System.

One Kendall Square

The shifting of the New England economy from a manufacturing base to a high tech and service base in

the latter half of the 20th century reduced the importance of the line for local freight service. For example, between Main Street and Binney Street, manufacturing facilities have been replaced by office and research/development facilities such as Technology Square, One Kendall Square, and Cambridge Center. MIT has purchased and redeveloped or demolished many of the industrial buildings between Memorial Drive and Main Street. Today there are no freight rail customers along the Grand Junction in Cambridge.

After the Massachusetts Bay Transportation Authority (MBTA) took over the Boston area commuter rail from the Boston & Maine and Penn Central Railroads, the Grand Junction railroad gained new importance. Beginning in 1977, a single commuter rail operator was contracted by the MBTA (initially the Boston & Maine RR was the contractor until 1987, when Amtrak won the contract, through 2003, when the Massachusetts Bay Commuter Railroad became the contractor). One result of this switch to a single regional operation was that equipment now needed to be moved regularly between north and south side operations. In 2001, Amtrak started its Downeaster service between North Station and Portland, ME, creating its own need to move passenger equipment between North Station and its maintenance facility at Southampton Street.

Corporate consolidations in the railroad industry have seen the Grand Junction railroad change owners from the New York Central to Penn Central to Conrail and now CSX Transportation. Currently, the Grand Junction line remains the only north-south rail connection east of Framingham and Worcester. A typical weekday sees four to six freight trains through the corridor, with occasional trains during weekends.

Project Setting

The Grand Junction corridor is located in the eastern portion of Cambridge. This is an urban area that is densely populated. The southern end of the corridor passes through the campus of the Massachusetts Institute of Technology (MIT), and borders on the Cambridgeport neighborhood. The middle section passes through the Kendall Square/Cambridge Center area, and borders on the Area Four neighborhood. The northern end passes through the East Cambridge neighborhood and business district.

The corridor runs northeasterly from the Charles River to just north of Main Street. From this point, the corridor runs to the north to the City Line at Gore Street. *For the simplicity of description, this report will describe the Grand Junction corridor as running north-south.*

Property boundary data and property tax record data are summarized on a series of seven drawings entitled "land ownership and easements" (see Appendix B). The preliminary alternatives analysis in Chapter 3 includes an evaluation of ownership and property impacts of the major alternatives for the proposed RWT.

Population and Employment

Population and employment data (see Table 2-1) was taken from the census tracks that lie within one-half mile of the Grand Junction corridor. The population – over 34,000 persons or approximately 34% of the city's population – includes residents in Cambridgeport, Area Four, and East Cambridge. Employment includes the Kendall Square/Cambridge Center area, MIT, and nearby employment centers such as University Park, portions of Central Square, business districts along Main and

Cambridge Streets, and various office, research & development, and industrial land uses along and near the tracks.

Table 2-1. Population and Employment

Population within 1/2 mile of corridor:	34,231
Employment within 1/2 mile of corridor:	56,017*

Source: Cambridge Community Development Dept., November 2003.
*This employment data is from 1999. Newer data is unavailable at this time; however, the figure is certainly higher given the expansion of office and R&D facilities.

Adjacent Land Uses and Zoning

The Grand Junction corridor passes through multiple land uses. Not surprisingly, that corridor until quite recently was heavily industrial in nature, reflecting a past land use pattern that was dependent on the railroad for transportation services. The corridor has been zoned for high-density commercial and industrial development since the inception of zoning in Cambridge in 1924. Beginning in the 1960s and accelerating since about 1980, land uses along the corridor have begun to change dramatically, reflecting contemporary economic influences and the changing nature of urban living.

Expansion of the adjacent MIT campus has begun to transform significant stretches of the corridor; academic, research, and residential uses are replacing old industrial or long vacant land along the corridor along Vassar and Albany Streets up to Main Street. Below Massachusetts Avenue, institutional housing is expected to become a predominant use along the corridor.

North of Main Street, redevelopment through private and public initiatives has transformed abutting areas to contemporary research, development office parks, and some housing.

North of Binney Street, formerly commercial and industrial parcels have been giving way to low to moderate density housing development in the spirit of the development typical on abutting neighborhood streets.

The entire corridor has been rezoned within the past twenty years to reflect contemporary views of how land adjacent to it should be developed (see Figures 2-1 and 2-2). Fourteen zoning districts of quite varied character have replaced the permissive high density, heavy industrial Industry B zoning district that prevailed along almost the entire corridor in the 1960s. In general, the trend has been to lower the densities permitted, restrict the kinds of heavy industrial uses previously allowed, and introduce housing as a permitted use everywhere. Between Massachusetts Avenue and Binney Street the highest densities are allowed at the center of the new office/research and development district at Kendall Square. North of Binney Street lower densities are imposed where housing at neighborhood densities have been building in the past and are encouraged in the future. South of Massachusetts Avenue high density institutional districts apply where the MIT campus is anticipated to expand. In lower Cambridgeport mixed use districts at moderate density prevail. The following are the current districts along the corridor (from south to north):

Special District 5: A medium density office district with a maximum height of 85 feet. Setbacks are required.

Special District 10: A low-density residential district with a maximum height of 35 feet. Setbacks are required

Residence C-2A District: A high-density residential district with a maximum height of 60 feet. Setbacks are required.

Special District 11: A medium density office district with a maximum height of 85 feet. Setbacks are required.

Special District 8A: A medium density residential district with a maximum height of 60 feet. Setbacks are required.

Special District 8: A medium density light industrial district with a maximum height of 60 feet. Setbacks required only for residential uses.

Special District 6: A high-density institutional residential district with a maximum height of 180 feet. No setbacks are required.

Residence C-3B District: A high-density institutional residential district with a maximum height of 120 feet. No setbacks are required.

Industry B district: A high-density heavy industrial district with a maximum height of 120 feet. No setbacks are required. This used to be the zoning designation along the entire length of the corridor.

MXD District: Mixed-use district guiding growth in the Cambridge Redevelopment Authority Kendall Square Urban Renewal Plan area. There is a maximum height of 250 feet. No setbacks are required.

Industry A-1 District: A medium density light industrial district with a maximum height of 45 feet; bonuses in density and height are given for housing development. Setbacks are only required for housing uses.

Residence C-1 District: A lower density multifamily residential district with a maximum height of 35 feet. Setbacks are required. This is the typical Eastern Cambridge zoning district in residential neighborhoods.

Business A District: A medium density neighborhood retail district with a maximum height of 45 feet. Setbacks are required only for residential uses.

Residence C-3 District: A height density residential district with a maximum height of 120 feet. Setbacks are required.

The setback requirements of the districts are noted particularly because where they are not required, new construction can occur right up to the lot line along the corridor. The center of the corridor frequently serves as the location of the boundary line between two zoning districts. In general, with the exception of the low density Residence C-1 district, development of 50,000 square feet of development would require a special permit from the Planning Board before the development could proceed, under the provisions of the Article 19.000 Project Review Special Permit procedures. The Planning Board would be free to review the impact of the proposed development on the Grand

Junction corridor during that process. Development of less than 50,000 square feet might be able to proceed without any discretionary planning permit from the City.

Where portions of the corridor are sold off to private parties abutting it, that land may be developed in any way permitted by the applicable zoning district.

In order to prevent the erosion of the potential of the corridor to serve as a multipurpose transportation route through the sale of land to abutters, consideration might be given to a set of special zoning regulations, put in place through the mechanism of a "pathway overlay district," such as was adopted in the Alewife area in 2006. Land could still be sold to private parties, but development would be prohibited within the corridor. Any development potential (in terms of floor area or parking spaces, for instance) would have to be used on portions of lots outside the corridor; the land within the corridor, however, could be used to meet setback or open space requirements.

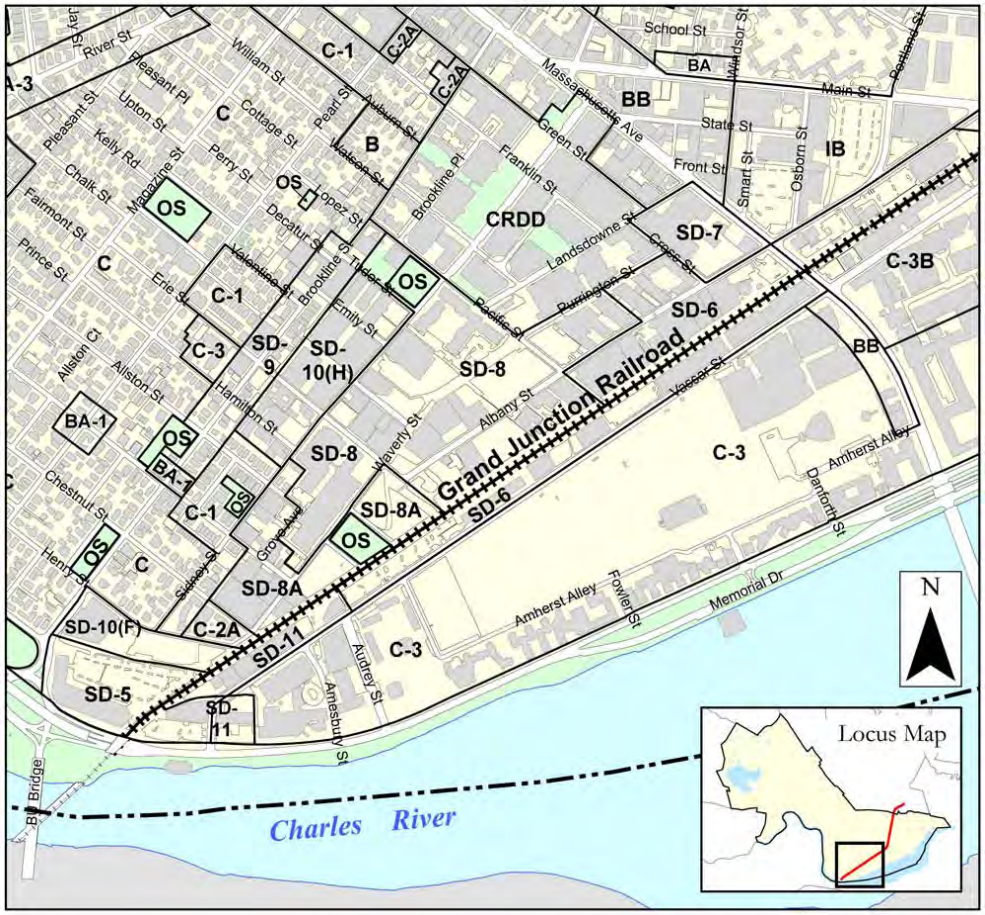


Figure 2-1 Zoning Districts along the Grand Junction Corridor (Southern End)

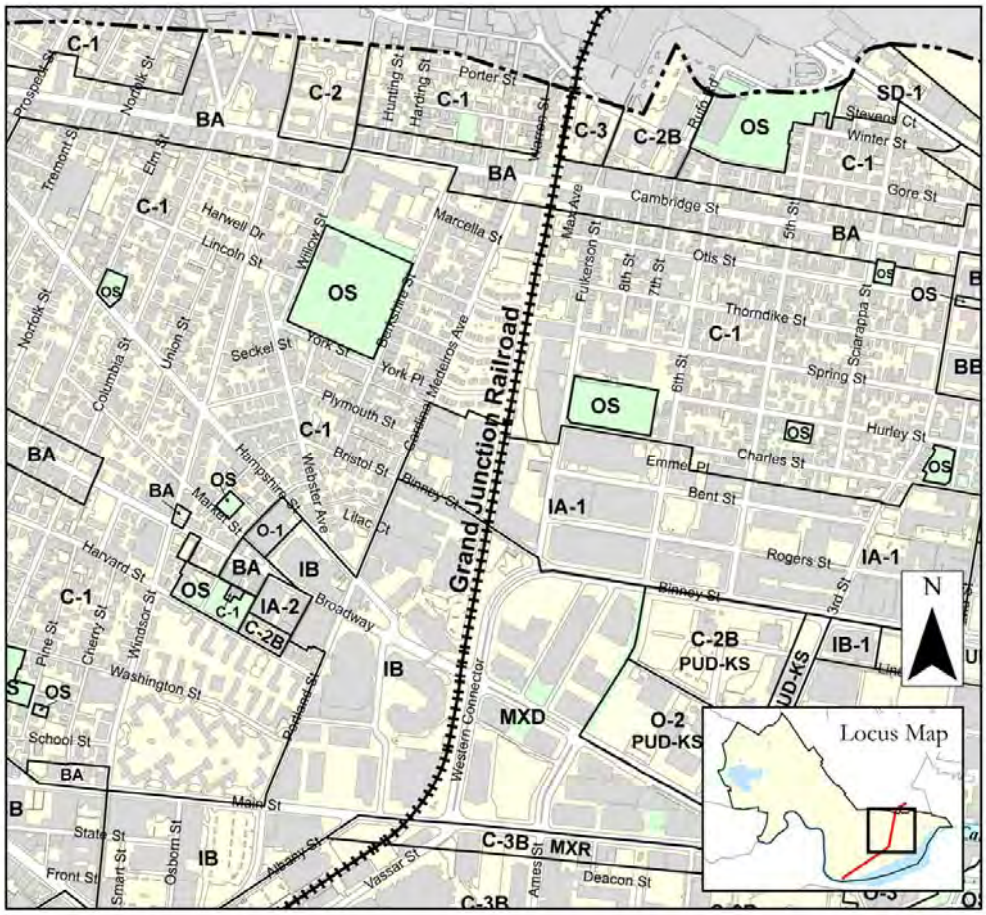


Figure 2-2 Zoning Districts along the Grand Junction Corridor (Northern End)

Property Ownership

The Grand Junction corridor is owned by CSX, MIT, the City of Cambridge, and other private property owners (See Table 2-2). Freight rail service on the Grand Junction railroad is currently operated by CSX, which owns much of the railroad right-of-way (ROW). The MBTA and Amtrak also operate a limited number of train trips on the line, primarily to shift equipment between the North and South stations in Boston.

Table 2-2. Summary of Trail Segments

From Location	To Location	Current Owner of Land Where Trail would be Located	Distance (feet)
750 ft west of Memorial Drive 00+00	250 ft west of Pacific Street Ext 30+55	CSX(a)	3055
250 ft west of Pacific Street Ext 30+55	Massachusetts Avenue 45+60	MIT	1505
Mass Ave* 45+60	Mass Ave 46+25	Cambridge	65
Massachusetts Avenue 46+25	Main Street 60+50	MIT	1425
Main Street* 60+50	Main Street 62+85	Cambridge	235 (b)
Main Street 62+85	Broadway 70+25	CRA	760
Broadway* 70+25	Broadway 71+10	Cambridge	85
Broadway 71+10	Binney Street 78+40	CRA	730
Binney Street* 78+40	Binney Street 79+35	Cambridge	95 (c)
Binney Street 79+35	Cambridge Street 97+45	Private	1810
Cambridge Street* 97+45	Cambridge Street 98+50	Cambridge	105 (d)
Cambridge Street 98+50	Gore Street 103+60	CSX	510
		TOTAL	10,360

* Refers to where the path crosses the street or along the sidewalk

(a) A portion of the former rail ROW just east of Memorial Drive is owned by MIT

(b) Includes 185 ft. long trail segment on west side of Main Street and rail crossing

(c) Includes 60 ft. long trail segment on east side of Binney Street and rail crossing

(d) Includes 55 ft. long trail segment along Cambridge Street and rail crossing

The Massachusetts Institute of Technology (MIT) purchased a significant length of the railroad corridor and former ROW. MIT's ownership of the corridor begins about 240 feet west of Pacific

Street Extension and runs east and north to Broadway. In this area, CSX holds an easement 32 feet wide west of Massachusetts Avenue and 16 feet wide east of Massachusetts Avenue. The wider easement encompasses the main track and a siding on the southeast side of the corridor. An initial property ownership search was performed in 2000 using the City of Cambridge Assessor's maps and database available at the city website. The results of the property ownership search are tabulated in Appendix B.[6]

[6] There may be changes in ownership that have occurred since this research was performed in 2000.

Current and Proposed Rail Operations

Track Layout

The Grand Junction railroad is a signal-less single track line with one active siding (the "long" siding.) (see Figure 2-3 below). It includes eight grade crossings and four grade-separated structures, as indicated in Table 2-3 and Table 2-4.

The Necco Spur is no longer in use and the City is moving forward with plans to convert the line into a bicycle and pedestrian multi-use path.

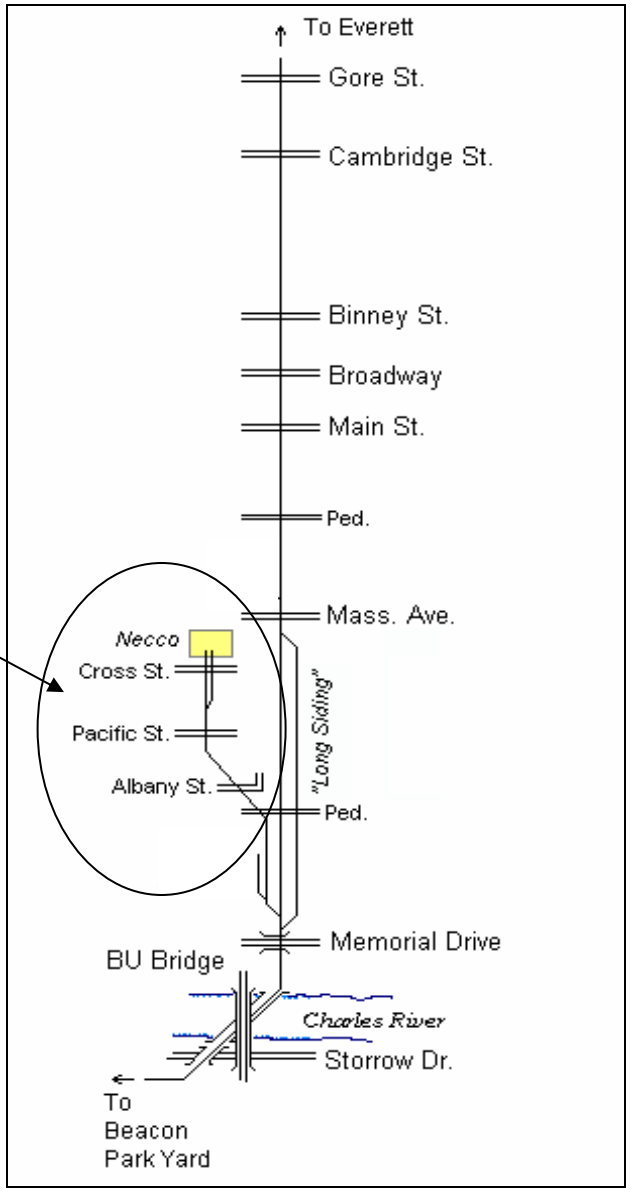


Figure 2-3. Map of Grand Junction Track in Cambridge

Table 2-3. Grade Crossings

Location	Type	Width of Crossing	Type of Crossing Protection	Comments
Ft. Washington	Pedestrian	--	Flashing Signal & Gates	Crossing protects main track and long siding. (Unused Necco spur is not protected)
Mass. Ave.	Road	4 lanes + 2 sidewalks	Flashing Signals, only	--
Ped. Crossing	Pedestrian	--	Flashing Signal & Gates	--
Main St.	Road	2 lanes + 2 sidewalks	Flashing Signals only	--
Broadway	Road	4 lanes + 2 sidewalks	Flashing Signals only	--
Binney St.	Road	2 lanes + 2 sidewalks	Flashing Signals only	--
Cambridge St.	Road	2 lanes + 2 sidewalks	Flashing Signal & Gates	--
Gore St.	Road	2 lanes + 2 sidewalks	Flashing Signal & Gates	--

Table 2-4. Grade-Separated Crossings

Location	Type	Width of Crossing	Type of Structure	Comments
RR over Charles River	Railroad Bridge	--	Triple through plate	One bay used for active track; other bay is not used.
Memorial Drive over RR	Roadway Bridge	4 lanes + 2 sidewalks	Simple span, steel girders, concrete deck	--
Pedestrian Bridge over RR	Pedestrian Bridge	Single walkway		Connects MIT garage and MIT land next to Albany St.
Utility Bridge over RR	Enclosed Utility Bridge	--	Assumed steel framed with cladding.	Connects MIT co-generation plant to chilled water facility.

Current Rail Operations

Three rail operators currently run trains over the Grand Junction line. CSX operates freight trains as a transfer run between its Beacon Park yard in Allston and its yard at the produce market in Everett. The Massachusetts Bay Commuter Railroad operates the MBTA commuter rail system; with passenger equipment transfer runs between its north side and south side operations. Amtrak uses the Grand Junction for equipment moves to support the Downeaster operation from North Station to Portland, ME.

Pedestrian bridge at MIT

A typical day may see four to six trains on the Grand Junction line through Cambridge. Train operations include CSX transfer runs, CSX car storage movements, MBTA equipment transfers, Amtrak equipment transfers, and special movements (e.g. Barnum & Bailey circus trains).

CSX yard engine

The car storage movement involves the movement of intermodal flat cars from Beacon Park yard to the long siding track between Massachusetts Avenue and Memorial Drive. Switches at each end of the side track allow the cars to be pulled into place, the power to be cut off, and the cars to return to Beacon Park on the main track. To allow passage at the pedestrian crosswalk at Ft. Washington, the line of stored cars is cut in two after it is shoved or pulled into place. This movement occurs from time to time when Beacon Park is crowded and additional temporary storage is needed.

The passenger equipment transfer occurs when MBTA passenger equipment (locomotives and cars) needs to be transferred between the north side and south side operations. The movements may include a single engine moving "light" or may include locomotives and cars pulled by an MBTA or CSX yard engine.

Table 2-5. Sidings and Spur Tracks in Cambridge

Track	Location	Description	Usage	Comments
CSX Long Siding	Memorial Drive to Mass. Ave.	Long side track	In use	Used to store overflow cars from Beacon Park yard; Also used for through traffic when circus train is parked on the main track.
Short siding	169 Waverly Street	Short siding	Not in use	
Former Necco/Stimpson spur track	Anglim Street to Cross Street	Long spur (3800'). Switch is just north of Memorial Drive.	Not used	Spur is parallel to main track until Ft. Washington Park. After the NECCO company left, there were no more uses for the spur. The City owns the portion from Ft. Washington Park to Purrington Street and is beginning the process of designing and creating a bicycle/pedestrian multi-use path along the spur
"MIT" siding	89 Albany St.	Short siding, just north of Mass. Ave.	N/A	The MIT siding was removed in 2003

Track speed is limited to 10 mph. All grade crossings are protected by flashing lights. (See Table 2-3) The crossings at Cambridge Street, Gore Street, and the two pedestrian crossings include gate arms. To activate the grade crossing signals, the train must stop as it approaches the crossing. Trains also use their horns to signal a warning when approaching a crossing.

Proposed Rail Operations

- Freight: Freight operations are expected to continue in the same manner as existing operations.
- MBTA: MBTA equipment transfer runs are also expected to continue.
- Possible North Station – South Station Rail Link: If the proposed rail link (tunnel), a project on indefinite hold, is constructed between North and South Stations, both the MBTA and Amtrak equipment moves along the Grand Junction would likely be switched to the new connection. However, freight operations would still use the Grand Junction line, as the link is intended only for passenger train operations.
- Possible Relocation of CSX Beacon Park Freight Yard: The CSX freight yard in Allston is on land owned by Harvard University. For the purposes of revenue for development, the Turnpike Authority may decide to develop the land for other purposes, which may lead to the need to relocate the freight yard. Depending on the location of the relocated freight yard, the Grand Junction line may or may not remain as the north-south freight link.
- Possible MBTA Urban Ring:

  At-Grade Alternatives: This option applies to Phase II and III of the Urban Ring. In Phase II, the bus rapid transit at-grade alternative would be a one-way at-grade busway entering the right-of-way in lower Cambridgeport and continuing to Main Street. In Phase III, the light rail at-grade alternative would emerge from a subway tunnel in the vicinity of Ft. Washington Park. With either mode, stops would be at Cambridgeport (near the park) and Massachusetts Avenue. At Main Street, either alternative would leave the right-of-way and pass through Kendall Square and turn up Third Street. The light rail alternative provides

for retaining the existing track (freight and passenger) next to the two light rail tracks. Where existing sidings are still in use, these tracks are also assumed to remain in addition to the two light rail tracks.

Below Grade (Subway) Alternative: This option would include a bored tunnel under the right-of-way. This option would potentially leave the surface conditions along the right-of-way essentially unchanged, except at the locations of stations and ventilation shafts. Bored tunneling would minimize the need to disturb the surface of the corridor while constructing the tunnel.

Existing Safety Conditions

Pedestrian Access to Right-of-Way

Though most of the right-of-way is fenced, there are frequent opportunities for pedestrians to gain access. These include all eight grade crossings and other openings in the fence, such as at Pacific Street and the unfenced section along Waverly Street. It is very easy for pedestrians to trespass within the right-of-way. With only a few trains per day and the low operating speed, there is little to discourage this behavior.

Train Operations

Existing rail operations are at very low speeds. Typically, trains travel at about 10 mph. At most of the signaled grade crossings, the train must stop in order to activate the signals. The low speed and frequent stops represent a low potential for train/vehicle and train/pedestrian conflicts.

3. ALTERNATIVE ALIGNMENTS

The Grand Junction corridor has been extensively studied, with a number of existing and proposed uses of the corridor. This chapter examines two primary alignment alternatives for a Grand Junction corridor trail.

The alignment alternatives analyzed in this section include:

- Option 1: Rail-with-Trail (RWT) only, using the full available ROW outside of the rail operations. This will be referred to as the *RWT Option*.

- Option 2: RWT and Bus Rapid Transit (BRT) one-way. Requires track relocation for the Charles River to Main St. segment of the trail. This will be referred to as the *RWT/BRT Option*.

Under each segment, the alignment options are discussed. Text and photos depicting significant issues, such as property ownership, intersections, and utility needs, are also shown. Detailed layout of the corridor is shown in the Appendix C. Note that Option 2 is the same as Option 1 from Main Street to Gore Street.

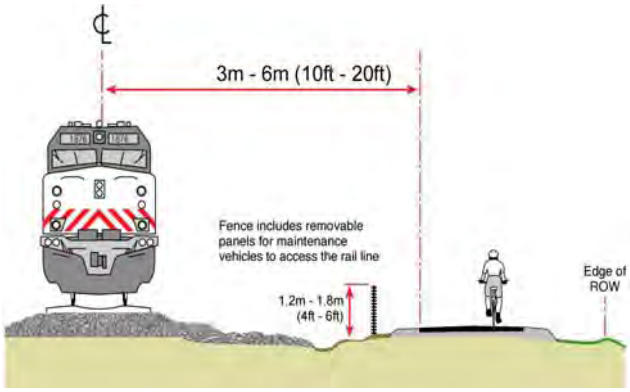
Two additional alignments were evaluated based on Urban Ring options that are no longer under consideration. One alignment was a light rail transit (LRT) facility in the corridor. In this alignment, the Grand Junction Trail was placed to the north of a shared railroad/LRT corridor. The second optional alignment for the Urban Ring included a two-way bus rapid transit (BRT). The analyses for these options are available through the City of Cambridge Community Development Department.

A third, "No build" option, using surface bikeways and sidewalks is described and discussed at the end of this chapter.

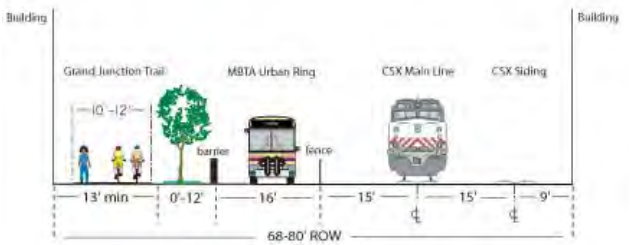
The Grand Junction Trail would accommodate a wide range of users including pedestrians, persons in wheelchairs and bicyclists of varied abilities. The path would accommodate family cycling. Assumptions regarding trail design include:

- Typical path width 12 feet
- Width of path shoulders 2 to 3 feet
- Typical setback from edge of trail to railroad centerline 20 feet, may be narrowed to 10 feet in restricted locations
- Trail setback from buildings 3 feet or greater
- Fence typically installed between path and railroad

More detail on the proposed trail design is provided in Chapter 4.



Typical Cross Section: Option 1



Typical Cross Section: Option 2

For the sake of the following descriptions of land use, ownerships, existing conditions, constraints and opportunities, the Grand Junction corridor through Cambridge is segmented as follows:

- **Section 1: Charles River to Ft. Washington Park**
- **Section 2: Ft. Washington Park to Massachusetts Avenue**
- **Section 3: Massachusetts Avenue to Main Street**
- **Section 4: Main Street to Binney Street**
- **Section 5: Binney Street to Cambridge Street**
- **Section 6: Cambridge Street to Gore Street**

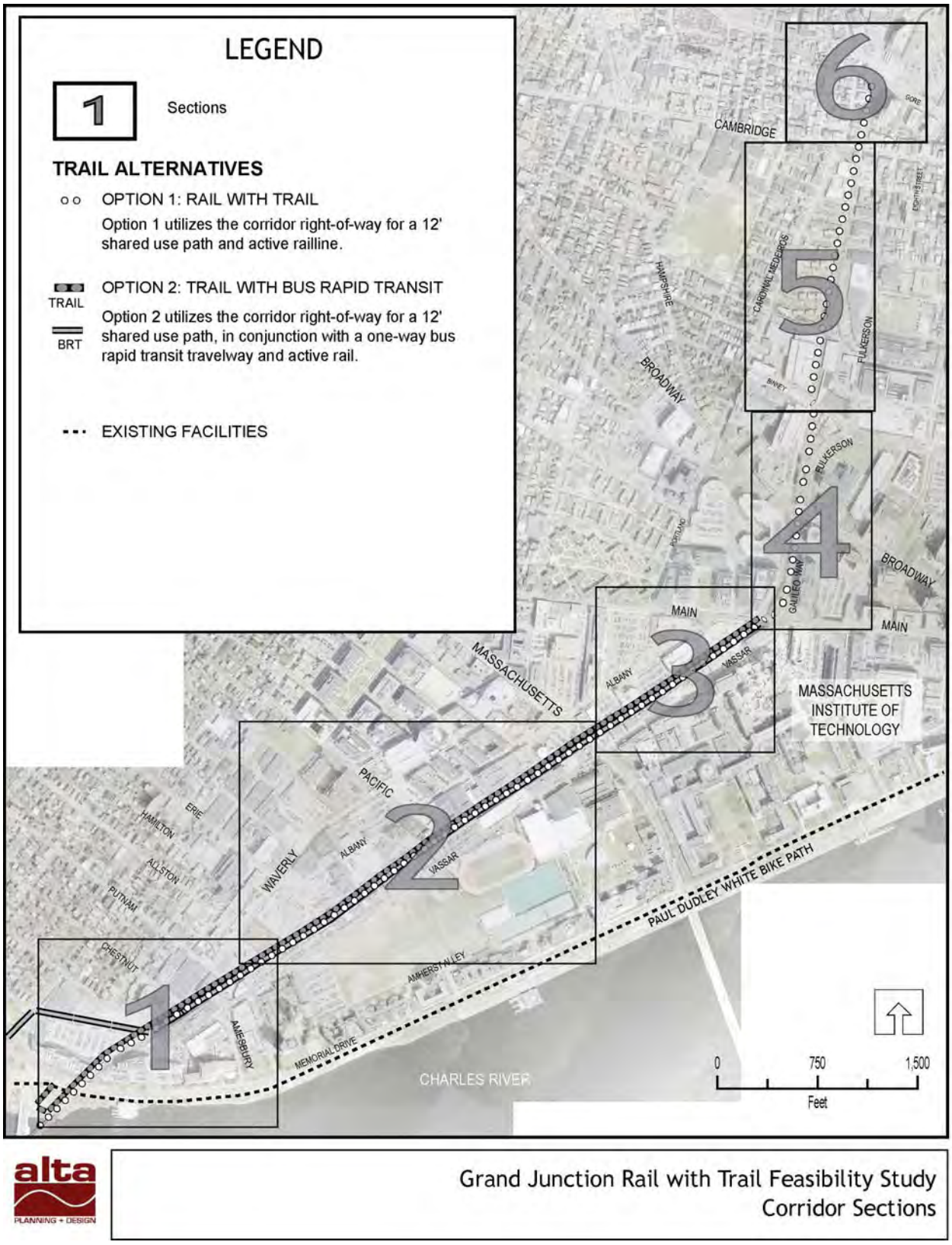
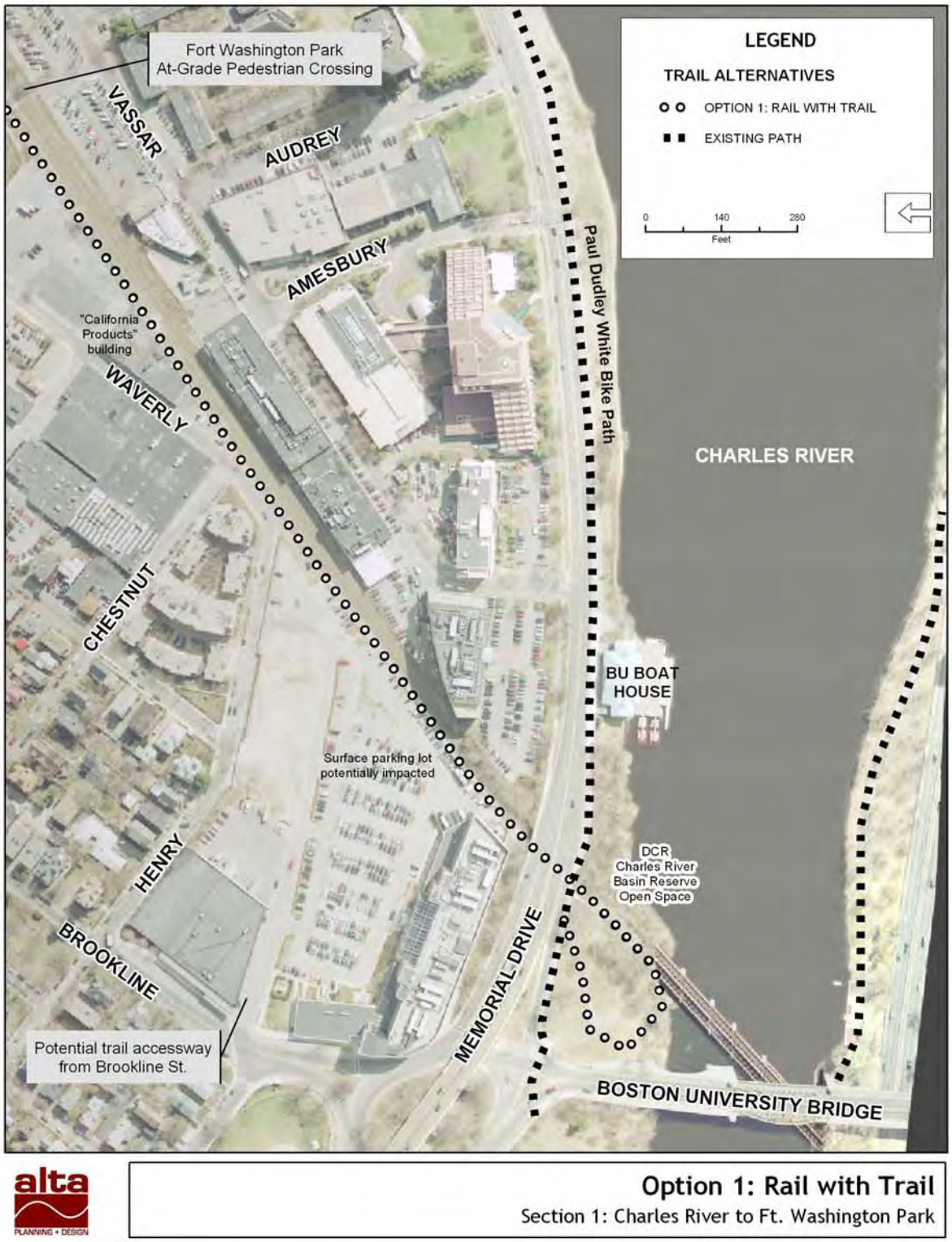
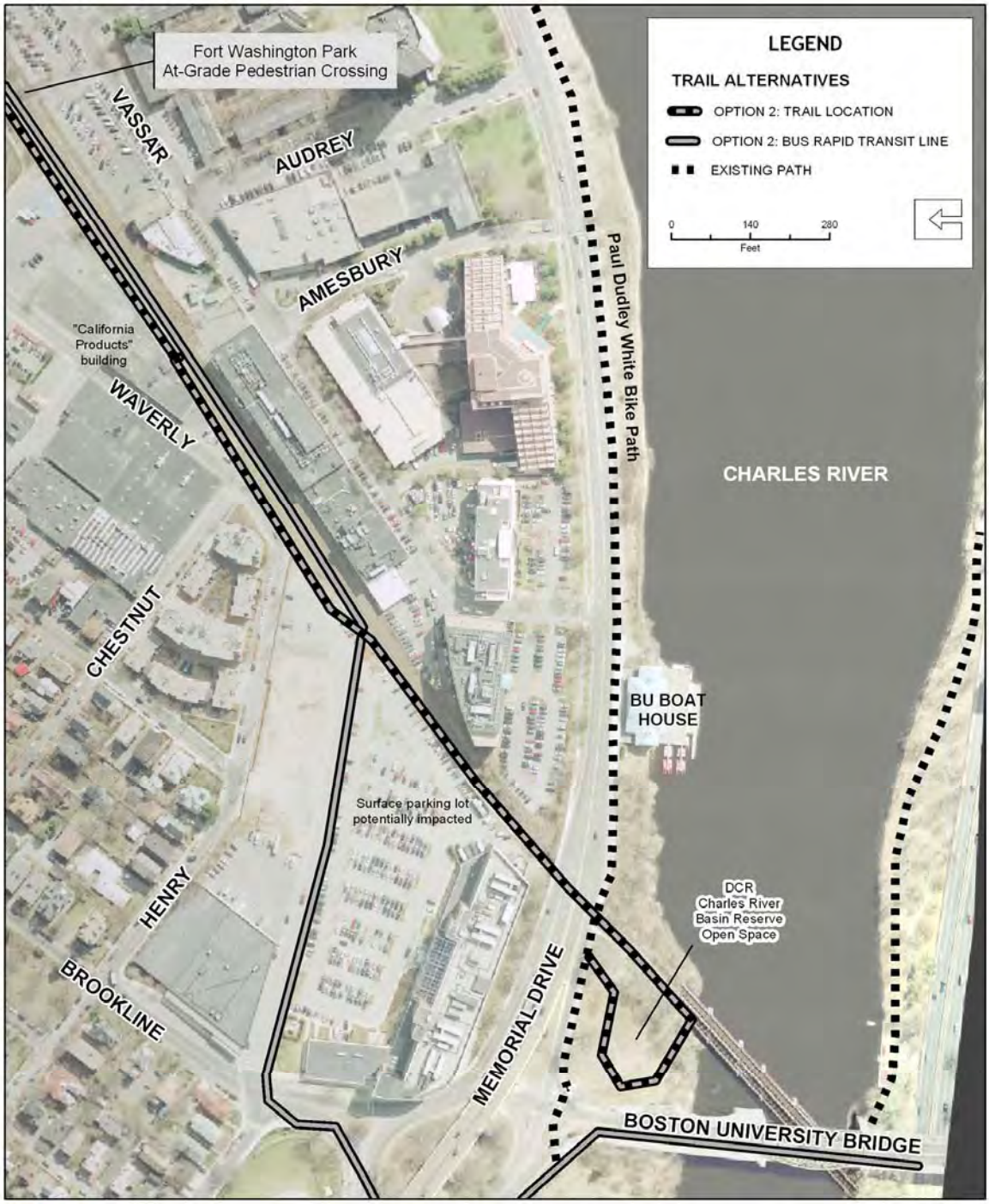


Figure 3-1. Grand Junction RWT Alignment Alternatives

Section 1: Charles River to Ft. Washington Park (RWT)



Section 1: Charles River to Ft. Washington Park (RWT/BRT)



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Option 2: Trail with Bus Rapid Transit
Section 1: Charles River to Ft. Washington Park

Section 1: Charles River to Ft. Washington Park

EXISTING CONDITIONS SUMMARY

The railroad bridge over the Charles River Basin is a 6-span, triple through-girder structure, originally built to carry two tracks. As seen in the top picture to the right, it passes diagonally under the Boston University (BU) Bridge (single span, steel arch) while it crosses the river. The bridge connects Boston in the midst of the BU campus with the Cambridgeport section of Cambridge.

Memorial Drive passes over the rail right-of-way on a single-span structure. Only one track passes under this overpass. However, the structure's span was set to accommodate two tracks. The distance between the abutments is shown in the second picture. The additional room under the bridge presents an opportunity for a possible path. The single track at Memorial Drive branches out to four tracks immediately north of the overpass. One long siding (east of the main track) extends to Massachusetts Avenue. West of the main track are the old Necco spur and a short siding. The Necco spur is out of use and is being removed.

The right-of-way is bounded by fencing and the rear of buildings. Fencing is typically chain link, 6 to 8 feet tall. The right-of-way is unfenced along Waverly Street between Chestnut and Henry Streets.

This section passes through former industrial land, with some residential uses and MIT facilities.

In the third picture, the four tracks are (right to left): the long siding, the main track, the Necco spur, and the siding. The physical right-of-way is entirely occupied by railroad infrastructure in this stretch.

OWNERSHIP

Open space - DCR Charles River Basin Reservation

Rail corridor right-of-way – CSX railroad and MIT

UTILITIES

For segments 1 & 2 (Memorial Drive to Pacific Street Extension)

The existing utility information available for this section of the pathway is limited. Information was obtained from GIS files obtained through the City of Cambridge DPW, some survey information obtained from the MIT Vassar Street Project and limited record maps from various utility companies.

There does not appear to be a substantial amount of utilities along the proposed pathway route within this section. A utility crossing is perpendicular to the railroad tracks and proposed pathway at Chestnut Street. The utilities confirmed to cross at this location are a 12-inch water main, a 6-inch gas main, a 12-inch sanitary sewer line and a 28-inch by 32-inch storm drain. It is unlikely that the utilities in this location will produce any conflicts with the construction of the pathway.

Looking southeast across the Charles River

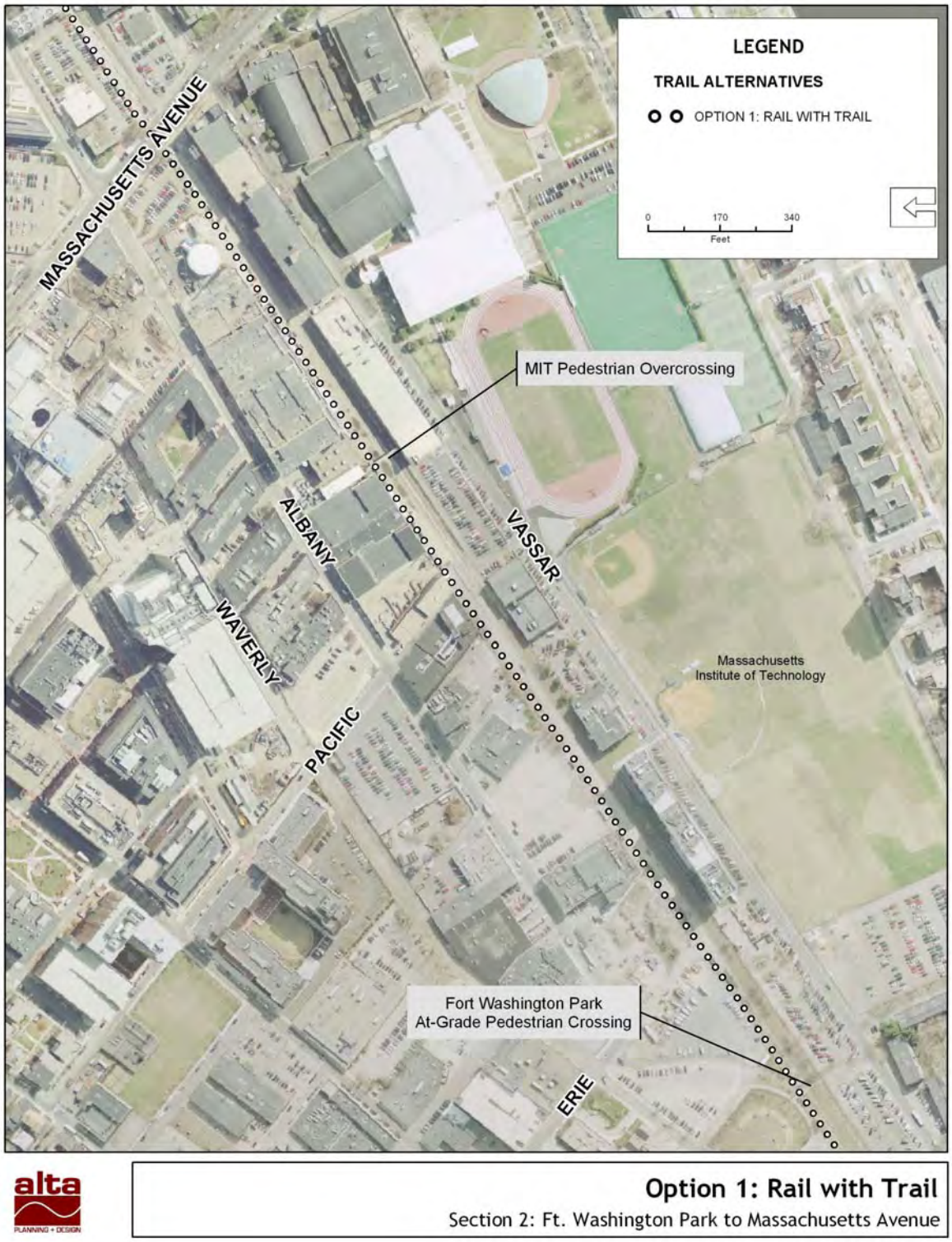
Memorial Drive Overpass: available room

Four tracks near Waverly Street and California Products

Section 1: Charles River to Ft. Washington Park

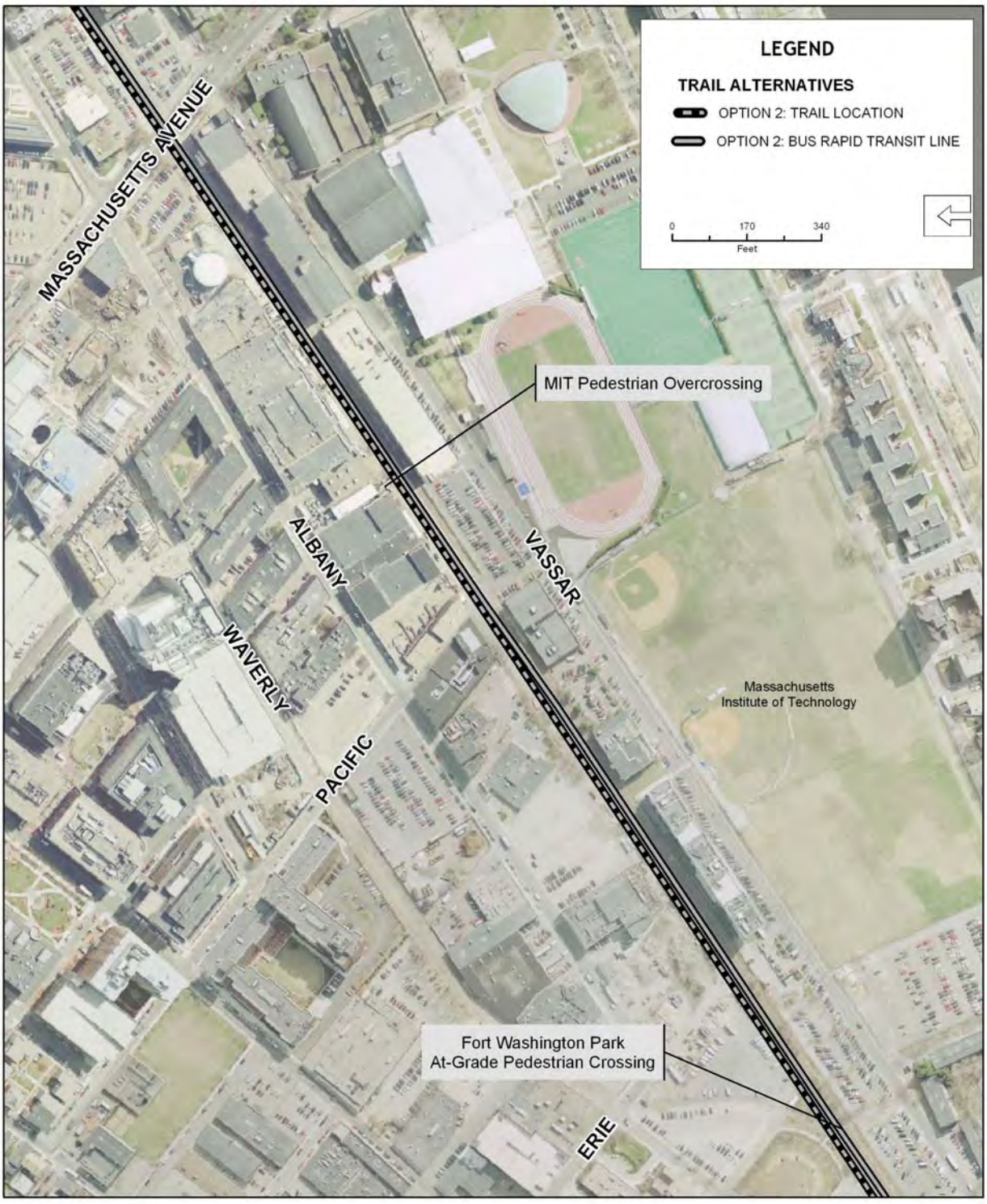
OPTION 1: RWT	**OPTION 2: RWT/BRT**
Description	Description
Connecting the Paul Dudley White Path with the Grand Junction trail is critical. For Option 1, the recommended connection is through the DCR Open Space to connect with the railroad undercrossing of Memorial Drive. In the section between the Charles River to just past Memorial Drive, a fence or protective barrier could be placed between the railroad track and the shared use path. Just north of the Memorial Drive bridge over the railroad, the shared use path would taper outward away from the railroad. Heading further north, the shared use path would occupy area now covered by siding that once served the California Products building. The path would remain on the west side of the Grand Junction Railroad (main line) to the vicinity of Main Street.	Connecting the Paul Dudley White Path with the Grand Junction trail is critical. The preferred connection would follow Option 1, with the path located on the west side of the corridor, with BRT in the middle and the rail to the east.
Setback Distance	Setback Distance
Charles River to Memorial Drive: 10 feet from railroad centerline. Memorial Drive to Ft. Washington Park: 20 feet from railroad centerline.	Dependent on the relocation of the CSX siding (and possible main line) in this section. With relocation, the setback would be approximately 30-40 feet from railroad centerline..
Key Issues	Key Issues
The short separation distance between the tracks and the proposed path at the beginning of this section. The short siding would most likely need to be removed to locate the path in this section. MIT owns the old California Products property and the buildings are currently unoccupied. If the site were redeveloped, it would be important to look at a building alignment with a greater setback from the proposed trail alignment. Northeast of Memorial Drive, the path would impact a portion of a surface parking lot and a mechanical unit on MIT property. Topographical constraints. Multi-jurisdictional area requires working with several agencies.	The movement, or removal, of the CSX long siding on the southeast side of the CSX mainline to accommodate both the Grand Junction trail and the Urban Ring. Narrow setback distance of trail from railroad centerline. Potential for necessary improvements to Amesbury Street and the intersection at Memorial Drive Potential for necessary improvements to the connection with the Paul Dudley White Bikepath. Potential conflicts between trail access from Brookline and the BRT line (although latest MTBA plans show this area still under review). Creating a safe at-grade crossing of both the Grand Junction line and the BRT for path users.

Section 2: Ft. Washington Park to Massachusetts Avenue (RWT)



Overcrossing refers to a specific type of pedestrian crossing that is elevated above the grade of the roadway/train tracks etc

Section 2: Ft. Washington Park to Massachusetts Avenue (RWT/BRT)



Section 2: Ft. Washington Park to Massachusetts Avenue

EXISTING CONDITIONS SUMMARY

This section of the Grand Junction corridor passes between the Cambridgeport neighborhood and the Massachusetts Institute of Technology (MIT) campus. This is the longest segment without a roadway grade crossing, although there is a pedestrian grade crossing adjacent to Fort Washington park.

The right-of-way is bounded by fencing and the rear of buildings. Fencing is typically chain link, 6 to 8 feet tall.

North of Ft. Washington Park, the physical right-of-way widens. The two tracks are along the east side of the right-of-way. West of the tracks is a wide (approximately 30 to 40 feet) area used as an unpaved access road. At Pacific Street, there is a private right-of-way that connects to Albany Street.

This segment includes a mix of industrial, commercial and institutional lands. However, not all of it is used for educational purposes. There are several buildings used for office as well as research and development. Other buildings are used as office or research and development, such as 270 Albany Street.

MIT facilities abutting the corridor include parking facilities (open lots and one garage on Vassar Street); office, classroom, and laboratory space; and a functioning nuclear power plant on Albany Street, used for research purposes.

The railroad crosses Massachusetts Avenue in close proximity to the Vassar Street and Albany Street intersections. Both intersections are signalized and have concurrent pedestrian phasing. Massachusetts Avenue is the busiest street crossing in the Grand Junction corridor. It has two travel lanes and a parallel parking lane in each direction (a few blocks have on-street parking on the north side only). Bicycle lanes are being added as part of the Massachusetts Avenue reconstruction project.

OWNERSHIP

The right of way is railroad-owned to a point approximately 200 feet south of Pacific Street. North of that point, the right-of-way is owned by MIT with an easement for the railroad

The corridor is owned by MIT with a 32-foot-wide easement granted to CSX. An additional 8-foot easement is granted to CSX for their siding.

UTILITIES

See Segment 1.

Segments 2 & 3: Utility information was obtained from As-Built and Survey Information for the Vassar Street project. Numerous utilities are located within the pathway, most of which are owned and maintained by MIT. These utilities include: MIT Electric, MIT Communications, MIT Chilled Water, MIT Hot Water and MIT Steam.

One or several of these utilities are located beneath the proposed pathway for the entire length from Pacific Street to Main Street. There are more than 40 structures (manhole covers and gate boxes) located within or immediately adjacent to the pathway within this section. Many of the ductbanks in this section have been installed with a minimal amount of cover.

Ft. Washington Park

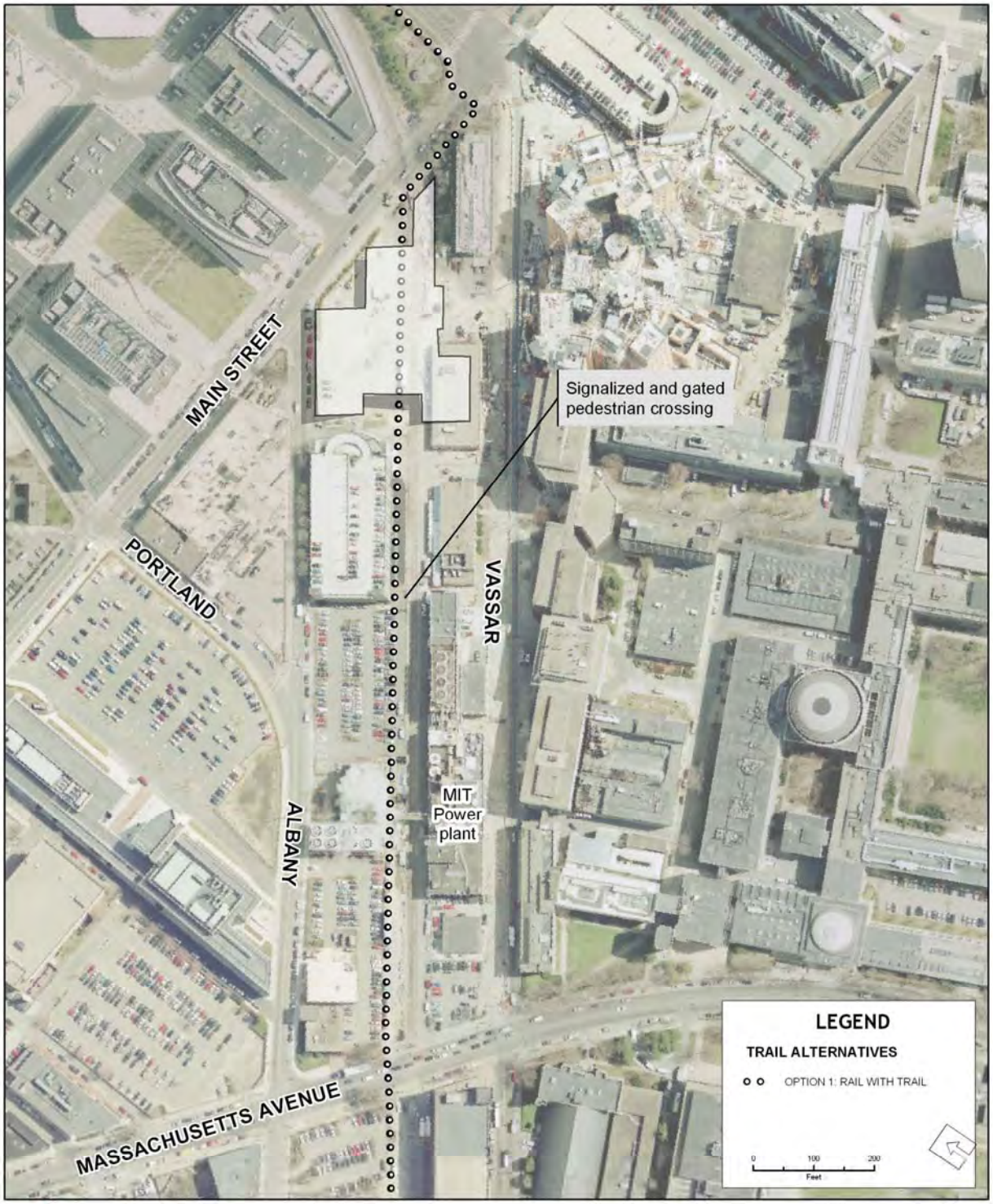
Looking north towards Massachusetts Avenue

Massachusetts Avenue Grade Crossing: Looking north from rail corridor

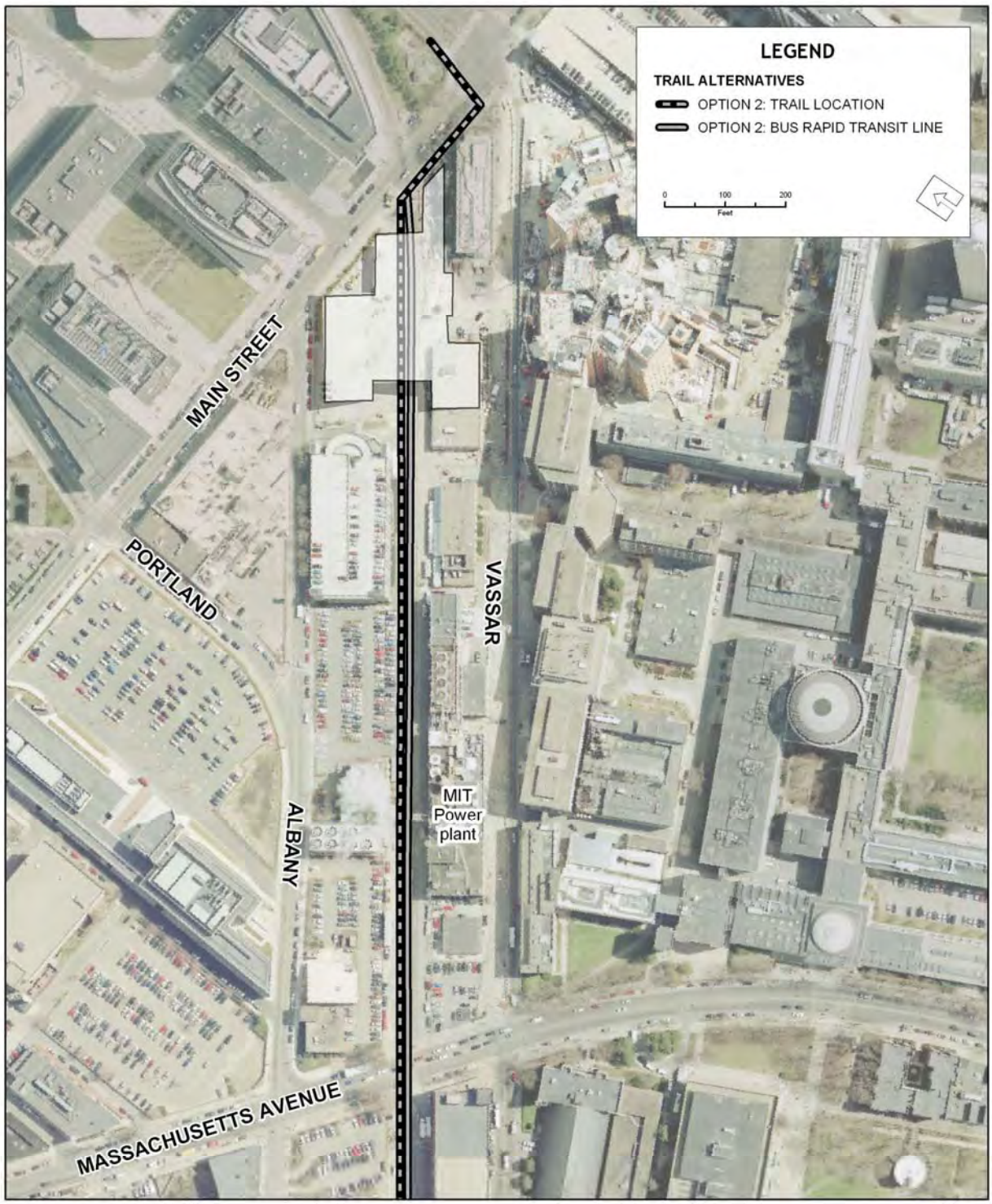
Section 2: Ft. Washington Park to Massachusetts Avenue

OPTION 1: RWT	**OPTION 2: RWT/BRT**
Description	Description
The path would be located on the west side of the Grand Junction railroad main line for this entire section. The path would be set back from buildings on the west side of the corridor by varying distances. The path would share the use of the service corridor and truck ramp behind several of the MIT buildings.	The path would be located on the west side of the Grand Junction railroad main line this entire section.
Setback Distance	Setback Distance
15 - 20 feet from the edge of the path to the railroad centerline.	Dependent on the relocation of the CSX siding (and possible main line) in this section. With relocation, the setback would be approximately 30-40 feet from the railroad centerline.
Key Issues	Key Issues
Working with MIT as the primary land and rail corridor right of way owner will be a key aspect of the success of the Grand Junction Trail. MIT has important service functions at the rear of the Plasma Fusion Laboratory. Maintenance of the service corridor behind this building is critical to the operation of MIT. MIT also expects an increase in the amount of service activity that will occur in this section of the corridor as more of their buildings come on line. At-grade crossing at Massachusetts Ave.	Working with MIT as the primary land and rail corridor right of way owner will be a key aspect of the success of the Grand Junction Trail. The movement, or removal, of the CSX long-siding on the southeast side of the CSX mainline through this entire section to accommodate both the Grand Junction Trail and the Urban Ring. The narrow separation distance from buildings on the southeast side of the corridor. At-grade crossing at Massachusetts Ave.

Section 3: Massachusetts Avenue to Main Street (RWT)



Section 3: Massachusetts Avenue to Main Street (RWT/BRT)



Section 3: Massachusetts Avenue to Main Street

EXISTING CONDITIONS SUMMARY

The track runs in a narrow corridor, with fences on either side. Along the east side, the chain link fence is generally 4-feet high, separating the track from an unpaved access road. On the west side, the fence varies in height from 4-feet to 8-feet.

A new MIT building, the Brain and Cognitive Sciences building, at Main Street between Albany St. and Vassar St., was recently constructed, and was designed to accommodate the BRT and a trail.

Paralleling the right-of way are Vassar Street (east) and Albany Street (west). There is a pedestrian crossing located between Massachusetts Avenue and Main Street.

The crossings in this section include a warning sign noting the presence of an AT&T transcontinental communications line running in the right-of-way.

This segment is entirely surrounded by MIT-owned land. Included are office buildings, a co-generation plant, a garage, and open parking lots.

The railroad crosses Massachusetts Avenue in close proximity to the Vassar Street and Albany Street intersections. Both intersections are signalized and have concurrent pedestrian phasing. Massachusetts Avenue is the busiest street crossing in the Grand Junction corridor. It has two travel lanes and a parallel parking lane in each direction. Bicycle lanes are being added as part of the Massachusetts Avenue reconstruction project.

North of Massachusetts Avenue, the Grand Junction line has a single track in the corridor.

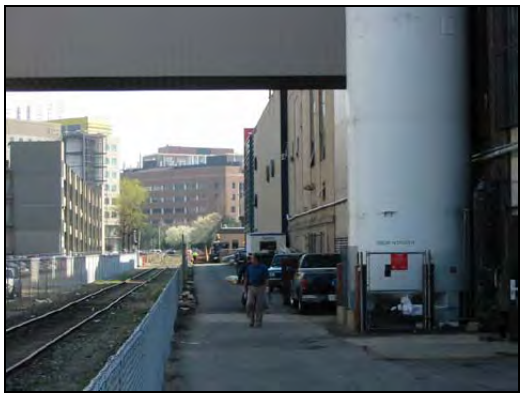
OWNERSHIP

The right-of-way is MIT-owned in this segment, with a 20-foot easement granted to CSX for railroad operations.

UTILITIES

See Segment 2.

Massachusetts Avenue Grade Crossing: Looking northwest from Vassar Street



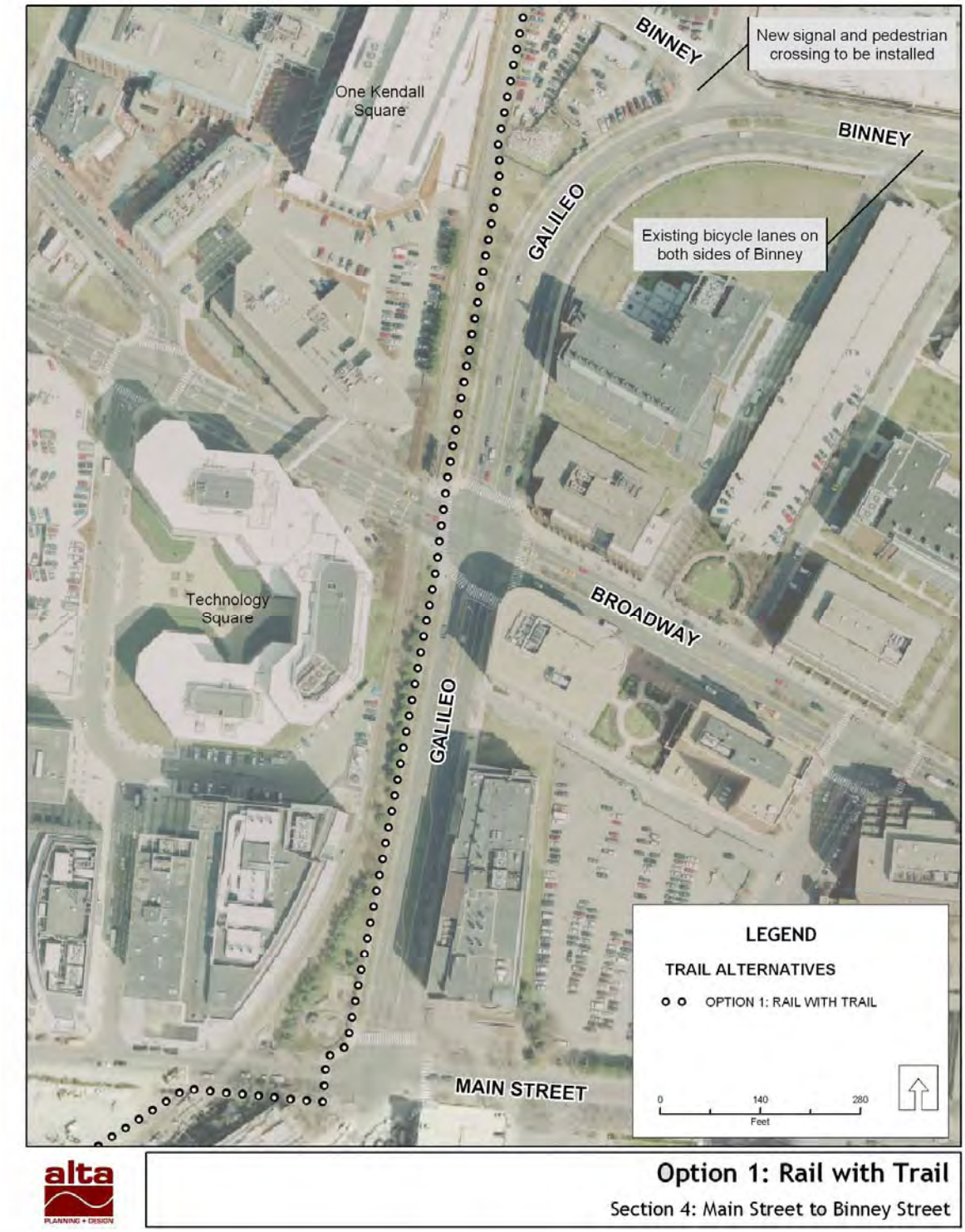
Looking north: MIT Power Plant on the right with large nitrogen tank

Signalized and gated pedestrian crossing of railroad south of MIT building 44

Section 3: Massachusetts Avenue to Main Street

OPTION 1: RWT	**OPTION 2: RWT/BRT**
Description	Description
The path would be located on the west side of the Grand Junction railroad main line for this entire section. The path would be set back from buildings on the west side of the corridor by varying distances.	The path would be located on the west side of the Grand Junction corridor.
Setback Distance	Setback Distance
20 feet from the edge of the path to the railroad centerline.	Dependent on the relocation of the CSX siding (and possible main line) in this section. With relocation, the setback would be approximately 30-40 feet from railroad centerline.
Key Issues	Key Issues
The new MIT Brain & Cognitive Sciences Center was designed to provide space for the trail on the west side of the corridor. Working with MIT as the sole land and rail corridor right of way owner will be a key aspect of the success of the Grand Junction Trail. From the path intersection at Main Street, users would have to use the existing sidewalk to the existing signal at Main St/Vassar St./Galileo Way.	The new MIT Brain & Cognitive Sciences Center was designed to provide space for the trail on the west side of the corridor. Working with MIT as the sole land and rail corridor right of way owner will be a key aspect of the success of the Grand Junction Trail. Potential conflicts between path users and of the service corridor located in this section behind the MIT Power Plant. Potential difficulties in meeting ADA requirements due to the slope of the corridor at certain points in this section.

Section 4: Main Street to Binney Street



Section 4: Main Street to Binney Street

EXISTING CONDITIONS SUMMARY

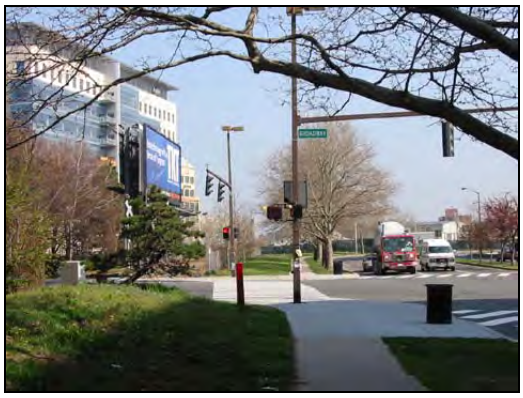
The section between Main Street and Broadway is very similar to the Massachusetts Avenue to Main Street segment. The track is situated in a narrow corridor defined by chain link fencing on either side. The trail is outside the rail corridor through this section.

To the west of this section is Technology Square, and office/R&D development that includes Draper Labs. To the east is a narrow strip between the Western Connector and the track which is owned by the Cambridge Redevelopment Authority. The strip is landscaped and features a mound or berm, planted with evergreen trees and grass.

From Broadway to Binney Street, the space between the fences is significantly wider. Chain link fencing lines each side of this segment of the right-of-way.

North of Broadway is "One Kendall Square," a mixed used development of office, R&D, and retail in renovated industrial buildings. To the east, the landscaped strip continues. Just north of the crossing at Broadway is a large billboard within the right-of-way.

This section also includes an AT&T transcontinental communications line running in the right-of-way. In addition, there is a Commonwealth Energy Corp. steam line running along the landscaped strip from Albany Street to Binney Street.



Looking north at crossing of Broadway

OWNERSHIP

For Option 1, the trail is shown on the south side of the rail corridor on land owned by the Cambridge Redevelopment Authority (CRA).

UTILITIES

Along the section of the pathway between Main Street and Broadway are several utility structures (steam vaults, electric manholes and traffic handholes) located within the grass area between the railroad tracks and the sidewalk. The grassy area is higher than the existing sidewalk in this area. Lowering the pathway to meet the existing grade of the sidewalk may require modifications to the utility structures. Other impacts may include traffic signal/street light conduit. Typically this conduit is installed at shallow depths. Construction of the pathway will require protection and/or relocation of these conduits.

The pathway between Broadway and Binney Street appears to run over an existing 30-inch storm drain and a 16-inch water main. It does not appear that the path will affect these utilities in this location.

A steam vault abuts an electric manhole in this section that could present a potential conflict. The top of the electric manhole steps down to a depth of approximately 18 inches below the top of the steam vault. It appears that this structure will need to be modified or rebuilt during construction of the project. The extent of the modifications should be investigated during the design phase of the project.

Looking north from Broadway

Section 4: Main Street to Binney Street

OPTION 1: RWT	**OPTION 2: RWT/BRT**
Description	Description
At Main Street, the shared use path would turn east on a wider sidewalk to the Vassar Street intersection. This requires the path to cross the railroad tracks at this point. The path would be at least 10 feet wide and separated from the travel way on Main Street by a verge 3 to 5 feet wide. The path would cross Main Street in the existing sidewalk on the west side of the Vassar Street intersection. Between Main Street and Broadway, the shared use path would be constructed on land owned by the Cambridge Redevelopment Authority (CRA). The path would be built as a separate path to the west of the existing sidewalk. The existing sidewalk is separated from the travel way by an 8.4 foot landscaped strip. The path would continue on the east side of the railroad from Broadway to Binney Street on land owned by the CRA.	There is no BRT for the rest of the corridor, so there is only one alignment option.
Setback Distance	Setback Distance
20 feet from the edge of the path to the railroad tracks centerline.	N/A
Key Issues	Key Issues
Creating a safe crossing of the Grand Junction railroad tracks at Main Street. The future use of the CRA property from Main Street to Binney Street that is currently in the planning process. Working with the CRA to locate and maintain the path.	N/A

Section 5: Binney Street to Cambridge Street

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Option 1: Rail with Trail
Section 5: Binney Street to Cambridge Street

Section 5: Binney Street to Cambridge Street

EXISTING CONDITIONS SUMMARY

This section includes the greatest variety of land uses along the corridor. The Kendall Square cinema and a large public garage are located immediately north of Binney Street on the west side of the tracks. North of this site is a residential neighborhood of semi-attached homes. On the east side of the right-of-way are industrial uses on Fulkerson Street, such as the Metropolitan Pipe Company. Near James Way, these industrial uses are mixed with condominiums.

To the west are mostly single and multi-family houses on 2500-square foot lots. Based on the property maps, it appears that each original parcel has acquired an adjacent sliver parcel of what was once the right-of-way. These sliver parcels have become extensions of the various back yards with some including small structures (e.g., garages). This side of the right-of-way is fenced with chain link, typically 4 to 6 feet high.

The length of the right-of-way is fenced, typically with chain link of various heights. Near the development of semi-attached homes, there is a second wooden fence, which supplies screening.

OWNERSHIP

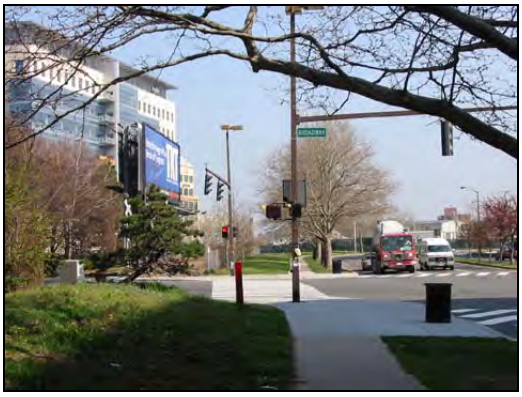
Along either side of the right-of-way, the assessor's maps indicate sliver parcels – evidence of land sold off by the railroad to abutters. The remaining railroad right-of-way is railroad-owned.

UTILITIES

For segments 5 & 6: Impacts to existing utilities appear to be minimal.

Any redesign of the parking lot at One Kendall Square to better accommodate the trail would require the relocation of existing area drains within the parking lot.

An 8-inch water main runs under the pathway for approximately 400 feet in this section. The water main, however, would not appear to have an impact on construction of the pathway.



One Kendall Square parking garage along Grand Junction corridor (looking north)

Looking north from Binney Street

Land on the west side of the railroad owned by Linden Park Homes

Section 5: Binney Street to Cambridge Street

OPTION 1: RWT	**OPTION 1A: RWT**
Description	Description
The shared use path is shown on the west side of the railroad between Binney Street and Cambridge. The path would be located on narrow slivers of property that were formerly part of the railroad corridor but apparently sold to abutters. For the most part, these slivers are undeveloped and could be used for a path without disrupting the adjoining land use.	Another option would be to locate the path on the east side of the railroad between Binney Street and James Way.
Setback Distance	Setback Distance
20 feet from the edge of path to track centerline.	12-20 feet from the edge of path to track centerline
Key Issues	Key Issues
Locating the path on the west side of the Grand Junction tracks requires an additional track crossing to be located at the Binney Street intersection. Acquiring the property or the rights to the right-of-way from the abutting properties in this section. Some redesign of the parking aisle on former railroad land would be necessary at One Kendall Square to maintain the 20-foot setback. Another option would be to decrease the trail setback from the railroad at this point. The path may have an impact on the parcel occupied by a Hair and Nail Salon on Cambridge Street. The path could possibly be moved closer to the railroad at this location or the building could be moved. Other options here include moving the railroad tracks and narrowing the path. More information is available in Appendix C.	The trail would be on the east side of the railroad from Binney Street to Cambridge Street. There are advantages to trail users in not switching sides of the tracks at both Binney Street and Cambridge. To maintain a 20-foot separation from the railroad tracks centerline, the tracks would need to be moved to the west after the Binney Street crossing, and a building addition within the Metropolitan Pipe & Supply Company complex would need to be removed. Further northeast, the path would encroach on an alley/drive for a series of multifamily residential buildings. This encroachment is significant and could render the residential parking inaccessible. At Cambridge Street the trail offset would again drop to 12 feet. More information is available in the Appendix C.

Section 6: Cambridge Street to Gore Street

Section 6: Cambridge Street to Gore Street

EXISTING CONDITIONS SUMMARY

North of James Way, and extending to Cambridge Street, are the facilities of St. Anthony's Parish, including the church, parish hall, and related buildings. At Cambridge Street, there are two small mixed use properties.

North of Cambridge Street, the adjacent land uses are mostly residential. To the east is the block-long Millers River Apartment complex. Near Cambridge Street, the complex's recreation room is adjacent to the right-of-way. North of this, the apartment building itself is set back from the right-of-way, with a masonry wall along the right-of-way. There is a row of trees and shrubs planted on the track side of the wall, apparently within the right-of-way itself. At Cambridge Street, there is also a landscaped planter area that also appears to be within the right-of-way, based on the property maps.

To the west are mostly single and multi-family houses on 2500-square foot lots. Based on the property maps, it appears that each original parcel has acquired an adjacent sliver parcel of what was once the right-of-way. These sliver parcels have become extensions of the various back yards with some including small structures (e.g., garages). This side of the right-of-way is fenced with chain link, typically 4 to 6 feet high.

North of Cambridge Street, the area west of the tracks is predominately multi-family residential uses, with some undeveloped lots.

OWNERSHIP

Along either side of the right-of-way, the assessor's maps indicate sliver parcels – evidence of land sold off by the railroad to abutters. The remaining railroad right-of-way is owned by CSX and the Cambridge Housing Authority.

UTILITIES

See Segment 5.

Looking north towards Gore Street (Cambridge Housing Authority on right)

Gore Street crossing looking towards industrial area in Somerville

Cambridge Street, with Millers River Apartments at right

Section 6: Cambridge Street to Gore Street

OPTION 1	**OPTION 2**
Description	Description
From Cambridge Street to Gore Street, the path would be located on the east side of the railroad.	N/A
Setback Distance	Setback Distance
20 feet from path to the railroad centerline	N/A
Key Issues	Key Issues
The path may impact a parcel occupied by a Hair and Nail Salon on Cambridge Street. The path could possibly be moved closer to the railroad or the building could be redeveloped or razed. Other options include moving the railroad tracks and narrowing the path. There is no separated trail continuing north of Gore Street at this point in time. A direct connection to the Somerville Community Path would be complicated and require a specialized study. Grand Junction Trail users can use on-street connections to North Point via Cambridge Street or Gore Street. Directional signage would be appropriate.	N/A

On-Road Options for Traveling in the Grand Junction Corridor

When a major facility project is envisioned, the primary focus of analysis is to identify the value and benefits the facility can offer. It can also be useful to examine the question of what people will be likely or able to do without the facility in place. This is often called the "No-Build Alternative."

In the case of the Grand Junction path, the answer to what people do now or will be likely to do in the future without it may be somewhat different depending on whether they are taking a recreational trip or a transportation trip. They would also be different depending on whether they are going by foot or by bicycle, or whether they are traveling alone, or with small children. Many factors would contribute to these decisions; discussed here is a brief review of some primary ones.

For recreational users, the lack of a facility within a short distance of one's home can mean that the trip is simply not made. Encouraging physical activity is a major national as well as municipal goal, and it is important to create additional options for recreational opportunities are constantly whenever possible. Another option is that people may choose to drive to a recreational opportunity. This would be unfortunate, as it is a major transportation goal to reduce vehicular trips wherever practicable.

For those who might potentially be using the path as a connector and coming from longer distances, a significant break in the network can be a deterrent for making the trip, or can inhibit longer trips.

For those who would be using the path as an attractive transportation link, there is no single route to travel using city streets that would meet the exact desire line, and what people would do is highly dependent on the mode of travel, the ease of the trip, and the directness of the route.

There are also differences for those making walking trips and those making bicycling trips. For most people walking, the choices are fairly extensive, as virtually all streets in Cambridge have sidewalks. Greater constraints exist for trips made by bicycle. There is a fundamental difference between taking a trip on an off-road facility and riding on the road. Some people are looking for a trip that is primarily using off-road facilities, with little on-street travel, so will only take a trip by bicycle if a path is nearby. For those who are choosing to bicycle using on-street facilities, determining an individual route will depend upon a variety of factors, including the specific destination, the directness of the route, and the comfort level for traveling on that route. If one looks at the map using a presumed origin and destination from one end of the Grand Junction to the other, there is no one obvious route for cyclists to take. The map on the following page shows the street network and existing and planned bicycle facilities in Cambridge.

Another important factor to think about is who is using the facilities. An adult may feel comfortable riding on the street him/herself, for example, but would not do so together with children. Even the street/sidewalk network creates limits where children are concerned. Parents may be able to feel comfortable allowing children to take a walk by themselves on an off-road path, whereas they would not for children traveling along larger, more trafficked streets.

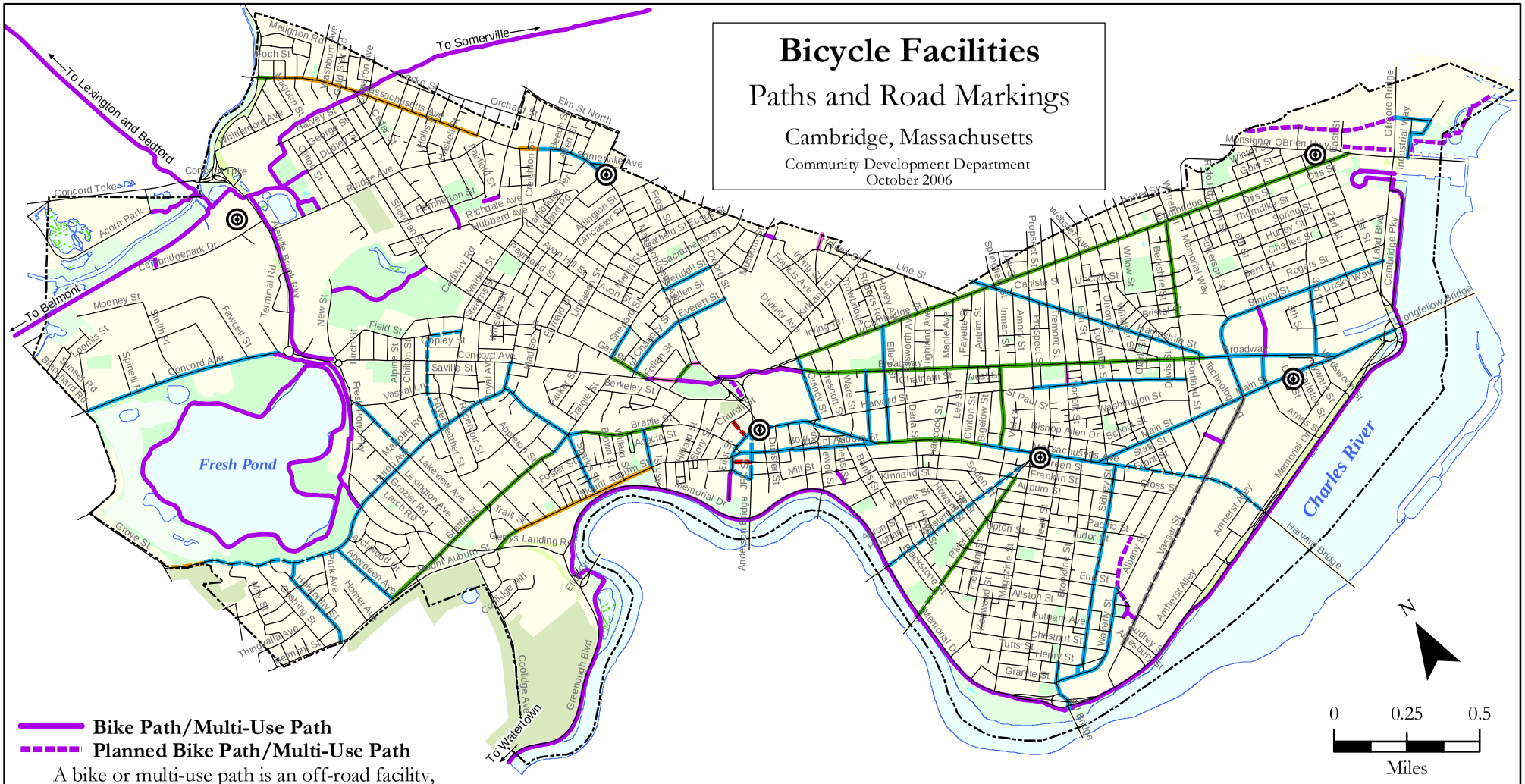
Conclusion: A Grand Junction trail would offer opportunities that don't currently exist, both in terms of route choice and connectivity and in terms of type of facility that makes the choices of bicycling and walking more available to a larger group of users.

Bicycle Facilities

Paths and Road Markings

Cambridge, Massachusetts

Community Development Department
October 2006



Bike Path/Multi-Use Path
Planned Bike Path/Multi-Use Path

A bike or multi-use path is an off-road facility, physically separated from motor vehicle traffic by an open space or barrier. Most paths are used by many forms of non-motorized travel (e.g., walking, skating, and jogging) in addition to bicycling.

Bike Lane
Planned Bike Lane

A lane on a street restricted to bicycles and designated by means of painted lines, pavement coloring, bicycle symbols, or other appropriate markings.

Contra-flow

A contra-flow lane is a bicycle facility marked to allow bicyclists to travel against the flow of traffic on a one-way street.

Cycle Track
Planned Cycle Track

Grade-separated bicycle lanes, usually located between the street and the sidewalk.

Shared Lane Pavement Marking
Planned Shared Lane Pavement Marking

A bicycle symbol marked on the pavement intended to remind motorists that bicyclists share the road. Used when there is insufficient space for bicycle lanes and specific bicycle markings are desired.

Edge Line
Planned Edge Line

Also known as guide lines or fog lines, these are stripes at the inside edge of the travel lane closest to the curb. When there is insufficient space for a bicycle lane, an edge line is sometimes installed to create space between the travel lane and parked cars.

Planned Shared Street

A street that is created as a common space to be shared by pedestrians, bicyclists, and low speed motor vehicles, all at the same level without grade-separated sidewalks.

For an 11" x 17" version of this map, go to http://www.cambridgema.gov/cdd/et/bike/bike_map.pdf

Map prepared by Brendan Monroe on October 11, 2006. CDD GIS d:\Projects\BikePaths\Facilities8x11.mxd

Potential Impacts on Utilities

The consultant team collected utility information from existing documents and field review. In the discussion of the segments below, the trail was assumed to be laid out per Option 1, which was used to illustrate the locations of utility impacts relative to the proposed trail route. The excavation required for the installation of sub-grade for the trail should be quite shallow (18 to 24 inches). Excavations to these depths should not be in conflict with any existing utilities within the pathway. However, changes to the existing grades along the pathway due to ADA requirements or drainage issues may create conflicts with existing utilities. The grading design for the pathway will need to be coordinated with the subsurface utility information to ensure that a sufficient amount of ground cover is maintained over all existing utilities.

The proposed stormwater collection system for the pathway could produce some conflicts with the existing utilities. The method for collecting stormwater has yet to be determined. Possible methods include:

- Collection of runoff with catch basins/area drains with the discharge to the City of Cambridge's existing stormwater collection system,
- Collection of runoff with dry well catch basins that infiltrates runoff into the ground, and
- Collection of runoff with drainage swales located on one or both sides of the pathway that infiltrate into the ground through a bed of crushed stone and into a French drain system.

The path might be constructed with a minimum pitch to either side allowing for sheet runoff and collection of runoff in existing drainage systems within the railroad corridor.

Whichever method, or combination of methods, is chosen for collecting the stormwater, the design of the system(s) will need to take into account the various existing utilities located within, and immediately adjacent to, the pathway. The proposed stormwater collection system will require the approval of the City of Cambridge Department of Public Works.

Utility access structures located within or adjacent to the pathway will need to be accounted for during the design of the pathway. Some of the utility structures that may affect or be affected by construction include: steam vaults, electric manholes, telecommunications manholes, traffic and streetlight hand holes and water gate boxes. Changes to the existing grades for the construction of the pathway will require the adjustment of frames and covers and possibly the modification or relocation of the existing structures. Any modifications or relocations of utility structures could be costly and impact the schedule of construction significantly. The design of the pathway should consider any of the potential impacts to major utility structures, and coordination with the appropriate utility companies is essential.

Utility owners will require maintenance or emergency access to utility structures that may restrict, or obstruct completely, access to the pathway. It may be necessary to provide a temporary bypass or widen the pathway in certain locations so that travelers on the pathway may still use the pathway during these circumstances.

Environmental Analysis

Based on a desktop review of readily available environmental records, Polyaromatic Hydrocarbons (PAHs), Petroleum Hydrocarbons, and metals are likely present in the surface soils along the proposed route of the bike path. Appendix E contains figures and a table summarizing several environmental sites that are in the vicinity of the proposed trail route.

Many of the reports reviewed contained information from local file reviews including City of Cambridge Fire Department and the Cambridge Historical Commission. SEA interviewed MIT personnel in the course of preparing several of the Phase I reports.

One significant report prepared by SEA is entitled "MIT Utility Design and Construction Oil and Hazardous Materials Investigation", dated September 22, 1999. This report contains detailed information about surrounding listed DEP sites, as well as analytical data for all of SEA's subsurface investigations along the CSX Railway and Vassar St. A total of 40 borings were completed along the CSX Railway and Vassar St. between the intersections of Amesbury St. and Vassar St. to the intersection of Main St. and Vassar St.

Based upon information gathered from completed field investigations, analytical results, and records review, the following observations apply:

- Reportable Concentrations of PAHs, Petroleum Hydrocarbons, or Metals under 310 CMR 40.000 are likely present in the soils at many of the sites within the route and within close proximity to the proposed trail.
- Evidence of subsurface contamination from both known and unknown sources of oil and hazardous materials was observed or detected in the soil and groundwater samples collected by S E A as specified in the report "MIT Utility Design and Construction Oil and Hazardous Materials Investigation", prepared by S E A.
- Due to the strong likelihood of the presence of contaminants, pre-characterization of the soils within the proposed trail should be performed primarily to assess the risk to construction workers, and to verify the presence and concentrations of contaminants. The number of pre-characterization samples necessary would be approximately 20 samples assuming a total trail length of 10,000 feet (1 sample/500 feet). The samples should be tested for arsenic, lead, and extractable petroleum hydrocarbons with target analytes.
- The presence of contaminants in the soil could pose a hazard to both the construction workers and the public welfare during trail construction. The main route of entry of contaminants would be through inhalation (air intake vents on buildings near the proposed bike path, construction workers exposed to dusts, etc.).
- A site-specific Health and Safety Plan (HASP) should be developed based on pre-characterization data to minimize the hazards to construction workers and the public during trail construction.
- Construction methods should be specified to minimize handling soils, to minimize the creation of an excess volume of soils, and to minimize the exposure of soils to construction workers and the public. Possible construction methods would include:

    1. Wetting soils with water prior to excavation to minimize generating dust;

2. Utilizing excess soils underneath the proposed bike path to the maximum extent possible by raising the final grade of the pathway;

3. Spreading soils with acceptable contaminant levels along the sides of the proposed bike path;

4. Mixing existing soils with structurally supportive soils to make the soils geotechnically suitable for reuse as a base for the proposed bike path to minimize excavation and removal;

5. Stabilizing either side of the proposed bike path with packed stone dust to minimize the public's future contact with the soil;

6. Installing fencing between the existing railroad rails and the proposed bike path to maximize safety of trail users from the railway and to minimize exposure of trail users to surface soils on the railway; and

7. Using landscaping techniques to cover the soils near the proposed bike path, thus limiting the exposure to the public.

- A modest amount of excess soils will likely be generated requiring proper disposal. Any soil destined for disposal must be sampled for full disposal characterization analytical data. It is usually required to characterize each 500 yd^3 of soil for disposal. The concentrations of contaminants in the soil will dictate the method and location for disposal. Approximate costs for disposal of different soils are listed below:
- The quantity of material disposed will determine the number of samples requiring full disposal characterization at a maximum of 500 yd^3 per sample. Assuming a modest amount of excess soils would be generated, the most cost-effective method would be to stockpile the excess soils accordingly and sample the stockpile for full characterization. The volume of the soil stockpile will dictate the number of samples needed (i.e., 300 yd^3 would require 1 full characterization sample; 600 yd3 would require 2 full characterization samples).

Intersections

The Grand Junction Railroad has six at-grade roadway crossings (Massachusetts Avenue, Main Street, Broadway, Binney Street, Cambridge Street, and Gore Street) within the City of Cambridge in addition to the grade-separated crossing at Memorial Drive. The crossings are relatively closely spaced and motorists within this urban area currently experience frequent and significant pedestrian activity. These factors reduce the typical concern over the unexpectedness of a pedestrian crossing at existing railroad/roadway grade crossings in the Grand Junction corridor. However, sufficient warning signage must be included at each crossing location to alert motorists and pedestrians to the crossing locations and regulations.

The proposed grade crossings along the Grand Junction corridor are summarized in Table 3-1, with design recommendations in Chapter 4.

Table 3-1. Roadway Crossing Recommendations

Roadway	# of Lanes	Width (ft)	PM Peak Hour Volume*	Recommendation
Massachusetts Avenue	4	62	2,050	New Signalized Crossing
Main Street	2	48	1,050	Routed to Existing Signal
Broadway	4	62	1,700	Routed to Existing Signal
Binney Street	2	32	500	Uncontrolled Crossing
Cambridge Street	2	52	1,300	Combine with existing Miller's River Apartment crossing
Gore Street	2	37	1,100	Uncontrolled Crossing

* PM peak hour volumes obtained from the MBTA's Urban Ring Study and the City of Cambridge (2003)

4. TRAIL DESIGN

This chapter provides specific design and implementation guidelines and standards to ensure that the Grand Junction Rail-with-Trail is constructed to a consistent set of the highest and best standards currently available in the United States. Ultimately, the Grand Junction Trail must be designed to meet both the operational needs of CSX and MIT as well as the safety of trail users. The challenge is to find ways of accommodating both types of uses without compromising safety or functionality.

Planning, design, and implementation standards in this document are derived from the following sources:

- Rails-with-Trails: Lessons Learned (August 2002)
- American Association of State Highway and Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Streets, 1994.
- AASHTO, Guide for the Development of Bicycle Facilities, 1999.
- U.S. Department of Transportation (USDOT), Federal Highway Administration (FHA), Manual of Uniform Traffic Control Devices (MUTCD), 2000.
- USDOT, FHWA, Selecting Roadway Design Treatments to Accommodate Bicycles, 1994.
- Florida Department of Transportation, State Bicycle/Pedestrian Program, Trail Intersection Design Guidelines, 1996.
- USDOT, FHWA, Conflicts on Multiple-Use Trails: Synthesis of the Literature and State of the Practice, 1994.
- Institute of Transportation Engineers (ITE), Design and Safety of Pedestrian Facilities, 1994.
- Rails-to-Trails Conservancy, Rails-with-Trails, Sharing Corridors for Transportation and Recreation, 1996.

The sources listed above provide details on many aspects of a rail trail, but a) may contain recommendations that conflict with each other; b) are not, in most cases, officially recognized "requirements"; and c) do not cover all conditions on most rail trails. All design guidelines must be supplemented by the professional judgments of the trail designers and engineers.

Recommended Width

The recommended width for paved multi-use trails is 14 feet in high-use urban areas, with 2-3 feet of lateral clearance and 8 feet of vertical clearance. In retrofit situations it can be difficult to achieve the desired 14', and 12' is commonly found. The minimum width from an operational standpoint is 8 feet in constrained situations and/or for short distances. Two-foot-wide unpaved shoulders with a compacted surface (often decomposed granite) should be located on each side of the paved surface to accommodate joggers and others who prefer a softer surface.

Signage and Striping

A yellow centerline stripe is standard for multi-use paths in Cambridge, especially when sections of the trail may incur heavy usage and/or where nighttime riding is expected.

Intersections and Crossings

In general, trail crossings should occur at established pedestrian crossings wherever possible, or at locations completely away from the influence of intersections. Mid-block crossings should address right-of-way for the motorist and trail user through use of Yield or Stop signs, or traffic signals that can be activated by trail users. Trail approaches at intersections should always have Stop or Yield signs to minimize conflicts with autos. Bike Crossing stencils may be placed in advance of trail crossings to alert motorists. Ramps should be designed to accommodate the range and number of users.

Specific trail crossing issues and treatments are discussed later in this document.

Design Speed

The minimum design speed for bike paths is 20 miles per hour, except on sections where there are long downgrades (steeper than 4%, and longer than 500 feet). Speed bumps or other surface irregularities should never be used to slow bicycles.

Horizontal Alignment

A 2% cross slope is recommended for drainage and accessibility, and should generally not be exceeded. The Grand Junction Rail-with-Trail runs along a linear corridor, with flat slopes. No sharp curves exist along the trail, except at trail entrance/exit points and at transitions at the north and south ends of the alignment.

Lateral Clearance on Horizontal Curves

Stopping sight distance on horizontal curves and lateral clearance can be calculated using the equations in the AASHTO Guide 2003. Sight distance is generally not expected to pose a problem on the Grand Junction Rail-with-Trail.

Gradients

Steep grades should be avoided on any multi-use trail, with 5% the recommended maximum gradient. Steeper grades can be tolerated for short distances (up to about 500 feet). The Grand Junction Rail-with-Trail corridor is nearly flat for most of the alignment.

Drainage

The 2% cross slope will resolve most drainage issues on a bike path, except along cut sections where uphill water must be collected in a ditch and directed to a catch basin, where the water can be directed under the trail in a drainage pipe of suitable dimensions.

Bollards / Barrier Posts

Posts at trail intersections and entrances may be necessary to keep vehicles from entering. Posts should be designed to be visible to bicyclists and others, especially at nighttime, with reflective materials and appropriate striping. Posts should be designed to be moveable by emergency vehicles.

Signing, Markings, and Traffic Control Devices

Bike path, bike lane, and bike route signing and markings should generally follow the guidelines as developed the Manual on Uniform Traffic Control Devices. This includes advisory, warning, directional, and informational signs for bicyclists, pedestrians, and motorists. The final striping, marking, and signing plan for Grand Junction Rail-with-Trail will be resolved in the full design phase of the trail, and should be reviewed and approved by a licensed traffic engineer or civil engineer. This will be most important at locations where there are poor sight lines from the trail to cross-traffic (either pedestrian or motor vehicle) such as at the Brain and Cognitive Sciences Building.

Rail-with-Trail Issues

This section provides guidance for specific railroad safety issues and other design issues related to rail-with-trails (RWTs). Much of the information in this section is based on the Rails-with-Trails: Lessons Learned Study. Again, engineering judgment and the requirements of the landholders must be applied.

Minimum Required Setback

Setback is measured from the nearest edge of the trail to the centerline of the nearest railroad track. No empirical data has been discovered indicating the precise setback that is recommended between a public trail and an active railroad. A review of 65 existing trails as part of the *Rails-with-Trails: Lessons Learned* report shows wide variance in the setback distance. Researchers attempted to determine if narrower setback distances have a direct correlation to safety problems. However, based on the almost non-existent record of claims, crashes, and other problems on these RWTs, they were unable to conclude a strong correlation between setback and safety. At an absolute minimum, the setback must keep trail users outside the "dynamic envelope" of the track, defined as "the clearance required for the train and its cargo overhang due to any combination of loading, lateral motion, or suspension failure."

Additionally, in corridors with regular use of maintenance equipment that operates outside the dynamic envelope, the setback distance should allow adequate clearance between the maintenance equipment and the trail.

The Federal Railroad Administration (FRA) already publishes minimum setback standards for fixed objects next to active railroad tracks, the distance between two active tracks, and adjacent walkways (for railroad switchmen). These published setbacks represent the legal minimum setbacks based on the physical size of the railroad cars, and are commonly employed along all railroads and at all public grade crossings. Most Public Utilities Commissions (PUC), which regulate railroad activities within states, also have specific minimum setbacks for any structures or improvements adjacent to railroads, including any sidewalk or trail that parallels active railroad tracks. According to the PUC standards, minimum distances from the centerline of an active railroad to the outside edge of a trail or bikeway is 8.5 feet on tangent and 9.5 feet on curved track.

The *Rails-with-Trails: Lessons Learned* Report outlines preferred setback distances, with encouragement toward as much setback distance as possible. It details circumstances under which a RWT can be set back a minimum of 10 feet, with greater width preferred. In the case of the Grand Junction corridor, the train speeds are slow (less than 20 mph) and frequencies are very low (four to six trains daily.) These meet the recommendations for a setback of less than 25 feet. Under Option 1 (with no BRT), the bulk of the corridor is able to have the RWT at a 20-foot setback, with a few tight spots where the trail setback would be 10 feet.

In all cases, reduced setbacks would be accompanied by increased safety measures such as high fencing.

Fencing and Barriers

A wide variety of physical barriers are used in RWT corridors. Of the 65 known RWT facilities operating in the United States today, 71 percent have some type of physical barrier between the trail and tracks. The types of barriers in use include fences, walls, vegetation, grade differences and ditches. MIT has indicated their preference for a fence between the trail and their property. It is assumed that CSX would prefer to see a fence separating the GJ RWT.

Fences are the most common type of physical barrier used in RWT corridors. A number of fencing types are available, ranging from simple low wood rail fences to tall, heavy-duty steel fences. Selection of a fencing type depends on the amount of trespassing anticipated along a given segment of the RWT, and the aesthetic qualities desired.

Need for Fencing

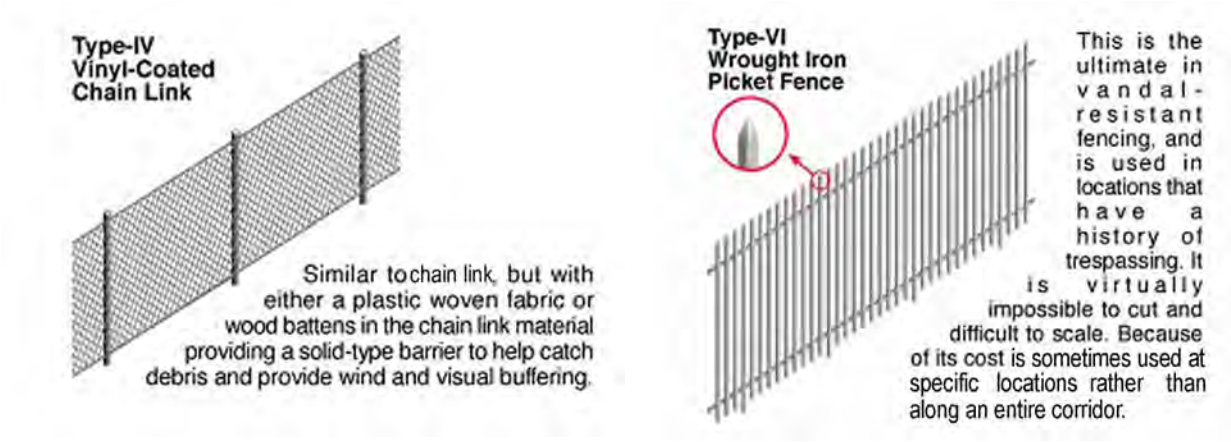
Some factors to consider when deciding on fencing necessity and styles include:

- Cost: Fencing and other barriers, depending on the type of materials used and the length, can be costly, so options should be considered carefully.
- Security: Fencing between the trail and adjacent land uses can protect the privacy and security of the property owners. While crime or vandalism have not proven to be a common problem along most multi-use trails, fencing is still considered a prudent feature. The type, height, and responsibility of the fencing is dependent on local policies.

- Fencing height: The height and design of a fence influences whether lateral movement will be inhibited. Few fences are successful at preventing people from continuing to cross at historic illegal crossing locations. Fencing that cannot be climbed will typically be cut or otherwise vandalized. Heavy-duty fencing such as wrought iron or other styles of fencing that are difficult to climb are often more expensive.
- Noise and dust: Although trains running along the corridor are low-speed and infrequent, they still generate noise, dust, and vibration, which may been seen as a nuisance to adjacent trail users. Methods of reducing this impact include the addition of vegetation or baffles to fencing barriers. This can increase the costs for a relatively low impact.

Fencing Type

Fencing style and material is a matter of local preference and railroad requirements. Some appropriate fencing types for the GJ RWT Trail would include the following:



According to the Metalco website, this fence style, Grigliato, is a very flexible and customizable system. It is suitable for commercial and industrial applications with medium to high security requirements. The system is based on a forge welded galvanized steel bar mesh.[7]

Figure 4-1. Fencing Types

[7] Information from the Metalco website (www.metalco.tv) viewed 01/28/06.

Recommendation

Fencing should be installed along the corridor. All fencing should be located a minimum of 10 feet from the nearest track centerline to allow for maintenance vehicles. Where the fence is located within 15 feet of the centerline of the nearest track, it should be designed to be removed as needed for rail maintenance work, unless adequate access can be provided on the opposite side of the tracks. All fencing should provide breaks or openings at least 5 feet wide every 500 feet to allow emergency access and escape.

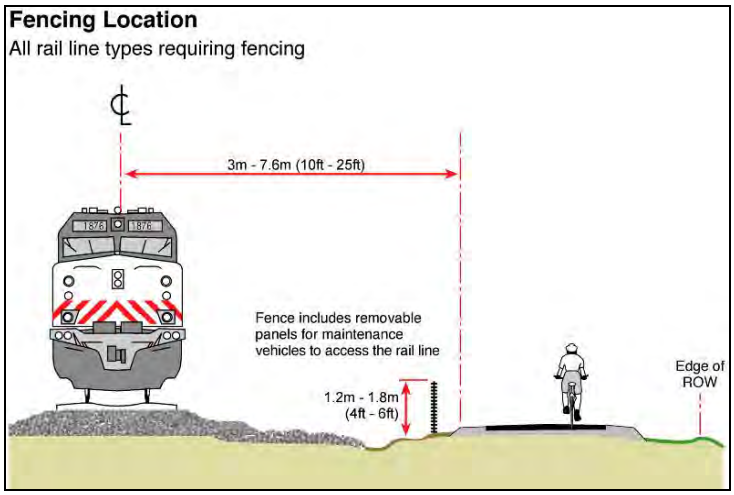


Figure 4-2. Fencing Location

With normal setback, fencing height should range between 36 inches and 48 inches, with 42 inches standard. On a roadway where the trail may be located closer than 15 feet from the edge of the trail to the centerline of the nearest track, the fence shall be at least 60 inches high with appropriate baffling material. Baffling material includes vegetation such as ivy or other vines, or a solid material such as wood.

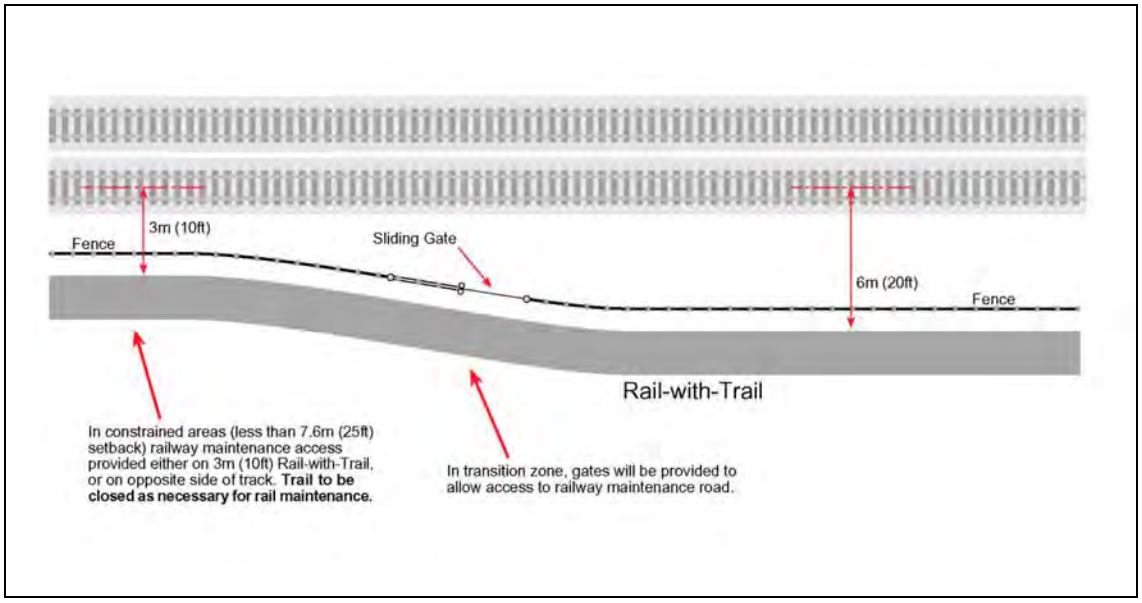


Figure 4-3. Railway Access

Regardless of fence type, railroad maintenance vehicles and/or emergency vehicles may need fence gates in certain areas to facilitate access to the track and/or trail. Fence design should be coordinated with railroad maintenance personnel, as well as representatives from utilities that extend along the corridor.

Vegetation

Whether natural or planted, vegetation can serve as both a visual and physical barrier between a track and a trail. The density and species of plants in a vegetative barrier determine how effective the barrier can be in deterring potential trespassers. A dense thicket can be, in some cases, just as effective as a fence (if not more so) in keeping trail users off the tracks. Even tall grasses can discourage trail users from venturing across to the tracks, although less effectively than trees and shrubs. Planted barriers typically take a few years before they become effective barriers. Separation between the trail and the track may need to be augmented with other temporary barriers until planted trees and hedges have sufficiently matured.

Trail-Roadway Crossings

The proposed Grand Junction Rail-with-Trail involves several at-grade roadway crossings, as well as three on-street track crossings. Each of these requires specific design treatments in order to ensure trail user safety, as well as compliance with railroad setback requirements.

Virtually all at-grade trail-roadway crossings are either unprotected, marked crossings, routed to an existing signal, or will require a new signal. Because of the proximity of the rail line, user movements must be considered.

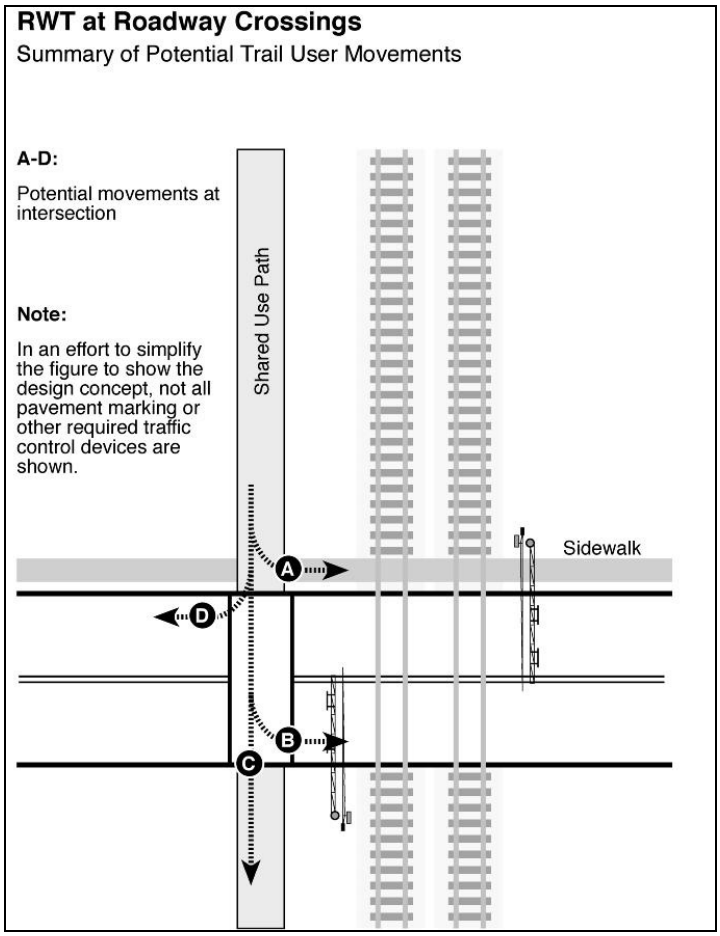


Figure 4-4. Trail-Roadway Crossings

The Grand Junction Rail-with-Trail crosses six at-grade roadways. Discussions of the individual crossings may be found in Chapter 3: Alternative Alignments. As noted earlier, the recommendations for design are:

Table 4-1. Roadway Crossing Design Recommendations

Roadway	Recommendation
Massachusetts Avenue	New signalized crossing coordinated with existing nearby signal
Main Street	Path users routed to existing signal
Broadway	Path users routed to existing signal
Binney Street	Uncontrolled crossing
Cambridge Street	Combine with existing Miller's River Apartment crossing

When considering a proposed off-street bike path and required at-grade crossings of roadways, it is important to remember two items: 1) trail users will be enjoying an auto-free experience and may enter into an intersection unexpectedly; and 2) motorists may not anticipate bicyclists riding out from a perpendicular trail into the roadway. However, in most cases, an at-grade trail can be properly designed to a reasonable degree of safety and meet existing traffic engineering standards.

Evaluation of bikeway crossings should involve an analysis of vehicular traffic patterns, as well as the behavior of trail users. This includes traffic speeds (85th percentile), street width, traffic volumes (average daily traffic and peak hour traffic), line of sight, and trail user profile (age distribution, destinations). A traffic safety study should be conducted as part of the actual civil engineering design of the proposed crossings to determine the most appropriate design features. This study would identify the most appropriate crossing options given available information, which must be verified and/or refined through the actual engineering and construction document stage.

Crossing Prototypes

Unprotected Crossings At "Little" Binney & Gore

Uncontrolled crossings (unsignalized, but with other traffic control devices) are recommended for streets with 85th percentile travel speeds below 45 mph and Average Daily Trips (ADTs) below 10,000 vehicles. All streets in Cambridge are signed at 30 mph or less; however, some of the streets have higher ADTs. An unprotected crossing consists of a crosswalk, signing, and often no other devices to slow or stop traffic. The approach to designing crossings at mid-block locations depends on an evaluation of vehicular traffic, line of sight, trail traffic, use patterns, road type and width, and other safety issues. See Figure 4-5 for general design.

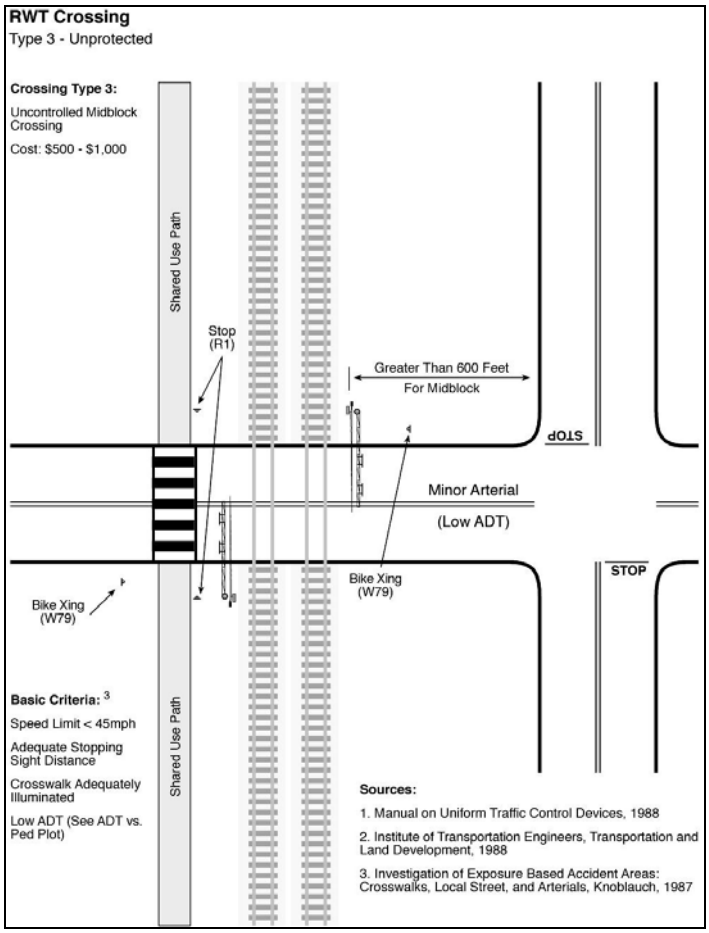


Figure 4-5. Type 3 RWT Crossing

Route to Existing Intersections (Main, Broadway, Miller's River, Manning Apts. on Cambridge)

Bike paths that either parallel a roadway or emerge closer than 200 feet from a protected intersection should be routed to that crossing in most cases. The reason is that motorists are not expecting to see pedestrians and bicyclists crossing so close to an intersection, traffic congestion may extend this distance, and the crossing may unnecessarily impact traffic capacity on a corridor.

Table 4-2 outlines the standard requirements for crossings at existing intersections.

Where the GJ RWT does not emerge at the existing intersection, carefully thought out physical design and directional signing will be required to keep bicyclists and others from crossing at the unmarked location. At the existing intersection crosswalk, all trail users will technically become pedestrians. Signs warning motorists of the presence of bicycles may be needed, as well as right turn on red prohibitions.

Table 4-2. Crossings at Existing Intersections

Standard Requirements	
Maximum Distance from Trail to Intersection:	Street Width 40 feet or less: 200 feet
	Street width over 40 feet: 350 feet
Length of barrier to prevent informal crossing	Street Width 40 feet or less: 50 feet
	Street Width over 40 feet: 100 feet
Intersection Improvements	Warning signs for motorists
	Right turn on red prohibitions
	Elimination of high speed and free right turns
	Adequate crossing time
	Pedestrian activated signals

One of the key problems with using existing intersections is that it requires bicyclists to transition from a separated two-way facility to pedestrian facilities such as sidewalks and crosswalks, normally reserved for pedestrians. Widening and striping the sidewalk (if possible) between the trail and intersection may help to alleviate some of these concerns.

Signalized Crossings (Massachusetts Ave.)

New or exclusive signalized crossings (Type 3) are identified for crossings more than 250 feet from an existing signalized intersection and where 85th percentile travel speeds are 45 mph and above and/or ADTs 10,000 vehicles. Signals require the input of local traffic engineers, who review potential impacts on traffic progression, capacity, and safety. On corridors with timed signals, a new trail crossing may need to be coordinated with adjacent signals to maximize efficiency. Trail signals are normally activated by push buttons, but also may be triggered by motion detectors. The maximum delay for activation of the signal should be 60 seconds, with minimum crossing times determined by the width of the street and trail volumes. The signals may rest on flashing yellow or green for motorists when not activated, and should be supplemented by standard advance warning signs. Typical costs for a signalized crossing range from $75,000 to $150,000. Along the Grand Junction corridor, one additional signalized crossing would be installed at Massachusetts Avenue that will be coordinated with existing nearby signals based on these issues.

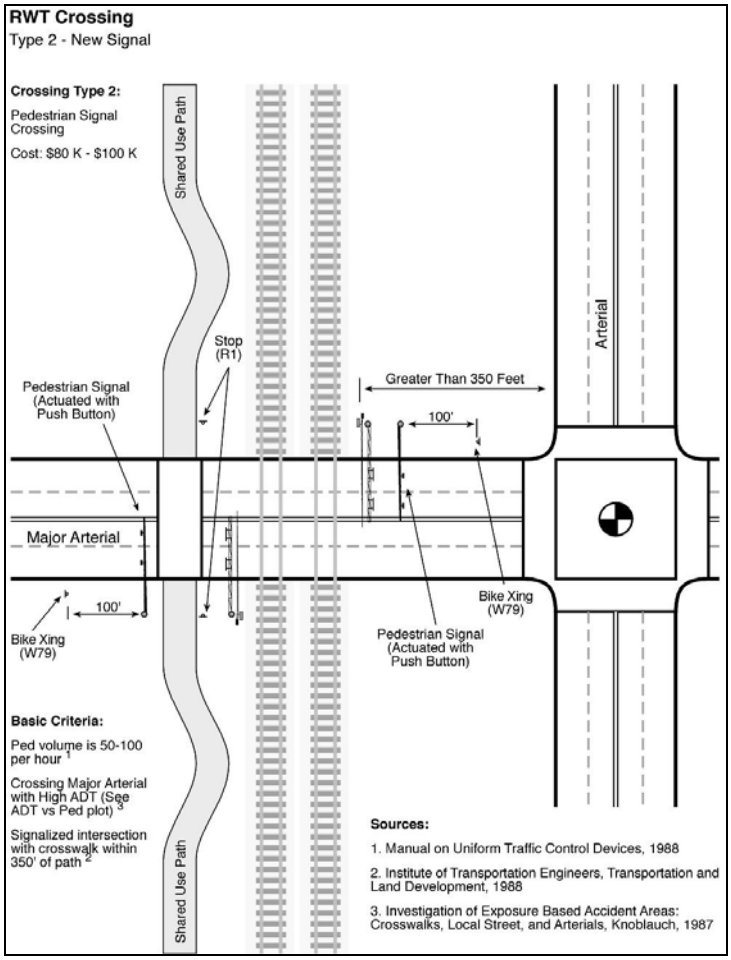


Figure 4-6. Type 2 RWT Crossing

Railroad Crossings

The preferred GJ RWT alignment would include no new at-grade crossings of the railroad tracks, although improvements might be necessary at the current crossings. New pedestrian railroad crossing flashers are typically not required for sidewalk crossings at legal crossings because they are redundant with adjacent vehicle crossing warning equipment. This type of crossing would be appropriate for Main Street where the trail crosses the Grand Junction tracks and is diverted to the signal at Main Street and Galileo Street.

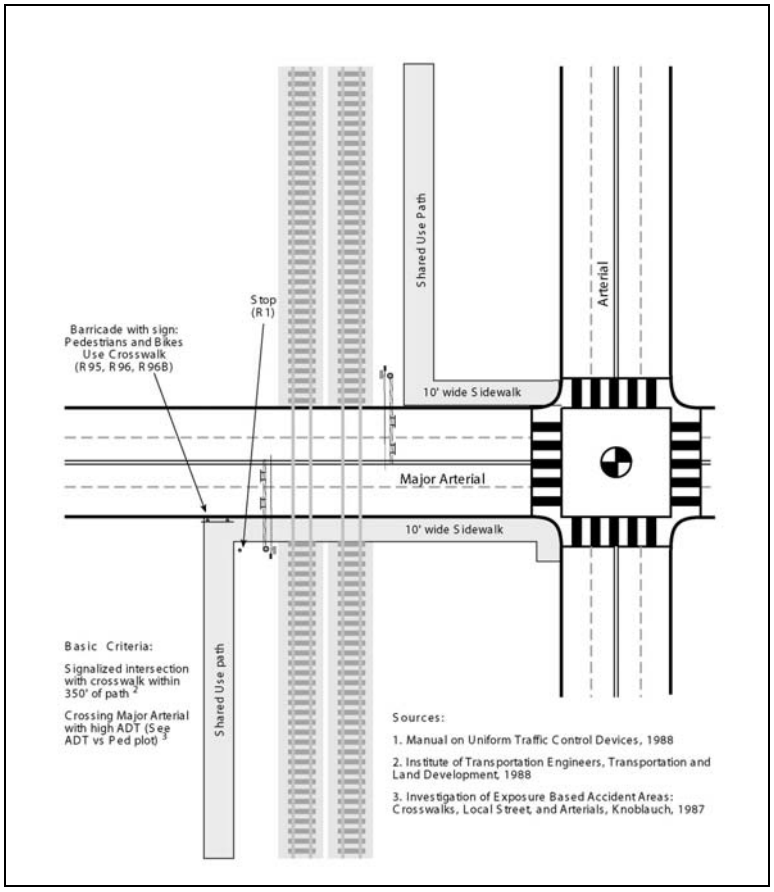


Figure 4-7. Railroad Crossings

Other Trail Design Issues

Utilities and Lighting

Surface and sub-surface utilities are located within the railroad right of way, impacting the location and construction of the GJ RWT. Utilities include active and abandoned railroad communications cable, signal and communication boxes, fiber optic cable, water and sewer lines, and telephone lines. The GJ RWT will be designed to avoid having to move most active surface utilities, although utility poles no longer in use may be removed. The trail may be located directly over existing sub-surface utilities assuming a) adequate depth exists between the trail surface and utility to prevent damage; and b) agreements can be reached with the utility owner regarding access for repairs and impact to the trail.

Trail lighting can be artistic, utilitarian, or both.

Installation of lighting along the Grand Junction Trail should be included to provide trail users extended hours of use, particularly during the winter months, and as an additional method in deterring crime along the corridor.

In general, lighting is recommended at trail access points and mid points between blocks to provide sufficient lighting for trail users and to help facilitate security surveillance of the trail from police vehicles. Light cut-offs are recommended to minimize unwanted light onto private property.

Signing and Marking

The GJ RWT should be designed with the recommended signing and marking in the Manual of Uniform Traffic Control Devices (MUTCD) in mind. It should also be identified by a consistent, unique logo or design that will help guide people to and on the trail. In general, all signs should be located three to four feet from the edge of the paved surface, have a minimum vertical clearance of 8.5 feet when located above the trail surface and be a minimum of four feet above the trail surface when located on the side of the trail. All signs should be oriented so as not to confuse motorists. The designs (though not the size) of signs and markings should generally be the same as used for motor vehicles.

Entrance Features

Major entrances to the GJ RWT may contain a variety of support facilities and other items, depending on available resources and local support. Typical entrance features would include:

- Trailhead. The trail will draw substantial numbers of users during peak times. A trailhead could provide amenities such as drinking fountains, telephones, bike lockers, or information boards. Public art and/or entrance signs may be placed at the entrance. Entrance signs should include all the relevant trail regulations. Signs may be placed at the entrances or at appropriate locations along the trail that provide brief descriptions of historic events or natural features.

- Bollards. A single 48-inch wood or metal bollard (post) should be placed on the centerline of the trail at all entrances to prevent motor vehicles from entering the trail. The bollard should be designed with high reflective surfaces and be brightly painted. The bollard should be locked to a ground plate and be easily removed by emergency vehicle operators.

Landscaping

Landscaping along the GJ RWT should provide intermittent visual relief. Shrubbery should be located to provide windows of visibility for safety and seasonal color. Alongside fencing, planting should be located to minimize maintenance and protect trail users from wind and noise. Intersections should be planted with groundcover and low shrubs in order to provide the required visibility for train engineers, roadway travelers (motorists, pedestrians, bicyclists), and trail users. Columnar trees should be planted that will not interfere with trains but will provide shade for trail users. Attention should be taken to plant groves to prevent "staccato" or "strobing" effects of rhythmic planting trees and shadows.

Choices of plants should respect the sharing of the right-of-way with the rail and introduce seasonal color and shade. Groundcovers and shrubs should be water-efficient. Trees selected should be both deciduous and evergreen, and located at the edges of the rail corridor, also providing a windscreen in places.

Irrigation should be predominantly drip, and plant materials should be capable of self-sustainability within two to three years. Irrigation should be minimal after establishment of plant material.

Public Art

In keeping with Cambridge's 1% for Art Program, any city-funded and built public project must include public art. The Cambridge Arts Council works with the project manager to select artists and incorporate appropriate art into the project.

Accesibility

Because Grand Junction is quite flat, meeting goals for accessibility should be straightforward. There are additional guidance documents for specific items that may require recommendations, such as FHWA's "Designing Sidewalks and Trails for Access, Part II, Best Practices Design Guide, 2001."

5. IMPLEMENTATION, PHASING AND COST

Options

The options outlined in Chapter 3 have been analyzed with the following criteria in mind:

a. Width available in the railroad right-of-way;
b. Impacts on landholders' ability to utilize their property;
c. Functionality for users;
d. Environmental impacts;
e. Integration into existing bikeway routes; and
f. Minimization of new railroad-trail crossings.

Overall, it is clear that Option 1: RWT works best in terms of trail implementation. It is recommended that the path be constructed on the northwest side of the railroad from the Charles River to Main Street. Placing the path on the northwest side of the railroad provides for enhanced access to the path from Cambridgeport and prevents conflicts with use of the railroad siding on the southwest side of the main line. This design also prevents interference with access to MIT buildings east of Massachusetts Avenue including the institute's power plant. For the most part east of the Memorial Drive Bridge, the path would be set back from the railroad centerline by 20 feet and would not directly impact any existing buildings or have significant negative effects on the use of adjoining property. The path would impact some surface parking spaces and a mechanical unit on MIT property within the corridor. The setback distance would vary from the standard 20 feet at the northern end approach to Cambridge Street and under Memorial Drive at the southern end.

North of Main Street, the path would primarily be located on lands formerly owned by the railroad but now owned by abutters including: Cambridge Redevelopment Authority (CRA), Spaulding and Slye, Linden Park Homes, the Archdiocese of Boston, and the Cambridge Housing Authority.

Option 2, the construction of both the one-way Bus Rapid Transit (BRT) and the trail in the Grand Junction corridor would be more difficult. The ideal cross-section for the corridor to accommodate all three uses - trail, BRT, and railroad – would be to have the path along the northern edge of the corridor next to the BRT, and the railroad along the southern edge. While this alignment would

require moving some of the CSX siding, it is still feasible and would be the option that would permit all uses to remain in the corridor.

Phasing Strategy

To maximize the ability of the City of Cambridge to build the Grand Junction Trail, a phasing strategy process, along with the creation of a special overlay district, is proposed (see Figure 5-1 on page 5-3). The creation of a zoning overlay district could be implemented immediately. The special district would preserve the potential of the corridor to serve as a multipurpose transportation route. Land could still be sold to private parties, but development would be prohibited within the corridor. Any development potential (in terms of floor area or parking spaces, for instance) would have to be used on portions of lots outside the corridor; the land within the corridor, however, could be used to meet setback or open space requirements. A similar Pathway Overlay District was created in western Cambridge in 2006.

Following the implementation of a zoning overlay district, the City can approach the construction of the trail in phases based on ease of construction, ownership issues, coordination required with CSX, physical constraints, and other issues. One phasing strategy is outlined below:

Stage 1: Main Street to Binney Street – Owned by CRA, no conflicts or issues with MIT or CSX.

Stage 2: Binney Street to Gore Street – Some private property ownership, ECAPS support, City should be able to assemble the land, does involve CSX property.

Stage 3: Memorial Drive to Main Street – Requires cooperation with MIT.

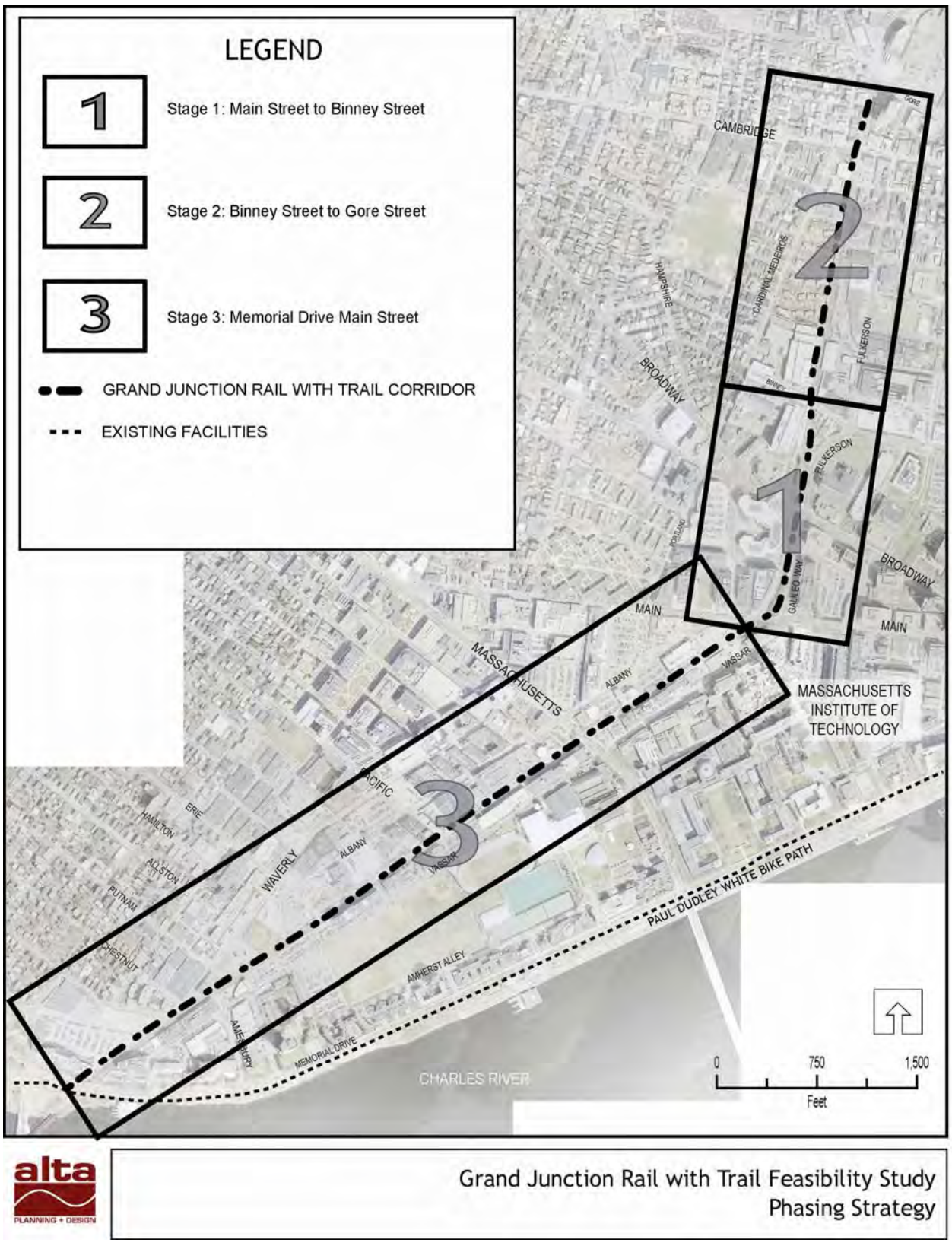


Figure 5-1. Phasing Strategy Map

Issues to Overcome

Clearly, there are many issues that would need to be overcome to fulfill these recommendations. Table 5-1 outlines starting point strategies for each of these, with the understanding that more detail should emerge as the project goes forward.

Table 5-1. Starting Point Issues and Strategies

Issue	Strategy
Working with MIT as a major land owner of the corridor	Work with MIT regarding liability and access to the corridor as early as possible.
Working with CSX as the main rail operator and major land owner in the corridor	Work with CSX regarding liability and access to their railroad tracks for maintenance. Highlight the benefits of the corridor to CSX
Acquire the rights to build the path along private property from both large landowners as well as the sliver properties in the northern section of the proposed trail	Meet with various landowners to discuss easements and licenses (see Chapter 4: Legislation, Liability and Insurance). Highlight the benefits gained for the landowners from the creation of the Grand Junction Trail.
Improve trail-street intersections and track crossings	Place bollards[8] and trail signs at all street/trail intersections so that trail users and drivers recognize the change in environment. Improve track crossings where necessary by adding signage, lights, and rubber flanges to the track to reduce the track width and improve the crossing for bicyclists.
Research potential public safety issues of creating a multi-use path adjacent to MIT's nuclear reactor	More research is necessary.
Create a successful management team and program for the trail	Requires a good working relationship with the other major property owners (specifically MIT and CSX) to create a management program that will satisfy the needs and requirements of all parties.
Connect Cambridgeport residents to the Paul Dudley White Bikepath	Improve the connection across the railroad track in at Ft. Washington to increase connectivity for the Cambridgeport residents.
Create a safe connection at Main Street to connect the on-street portion of the trail with the Grand Junction corridor portion of the trail	Ensure that the crosswalks and signals located at the intersection of Vassar and Main Street are sufficient for the numbers of potential users that will be crossing over to the west side of the intersection to continue north on the Grand Junction Trail.

[8] Bollards can be very effective when used and installed properly. Two permanent bollards at the trail's edge and one removable bollard in the center of the trail serves to keep all but the most determined vehicle traffic off the trail. Maintenance vehicles and emergency vehicles are equipped to remove the center bollard to gain full access to the trail and corridor. From a trail user perspective, bollards serve as a visual warning that they are approaching an intersection and care is required. Bollards need to be brightly painted to prevent trail users from crashing into them, particularly at night. The width and spacing of the bollards is important relative to the width of the trail itself. There needs to be sufficient room on either side of the bollard for a bike with a trailer to pass successfully without leaving the trail.

Cost

The overall cost of the trail includes several components:

- Trail construction cost (including fencing and trail/roadway intersection improvements)
- Trail design cost
- Acquisition of land takings, easements, or licenses

Table 5-2 provides a breakdown of the trail construction costs using a combination of MassHighway Weighted Average Bid Prices (2004) and recent bids for construction contracts in the City of Cambridge for two different options. The cost includes clearing an 18-foot wide area for trail development. A 12-foot wide area would be excavated to a depth of 6 to 8 inches with the material spread to the sides of the path. The trail would be 12 feet wide with a structure consisting of a 10-inch gravel base and a 2.5-inch asphalt surface course. The shoulders would be 3 feet wide with 3 inches of loam over the spread excavated material. No existing material would be removed from the site.

A design cost of 10% of the total construction cost and a construction oversight cost of 10% of the total construction cost has been assumed for purposes of showing an overall cost for the design and construction of this project. A construction contingency of 40% has also been included. This contingency is used to accommodate unforeseen conditions that arise during detailed design as well as construction. Because of the complexity of the corridor involved, it is recommended that a thorough, itemized design fee be developed once a concept has been chosen to provide a more accurate cost.

Costs related to land takings, easements, or licenses are not included in this estimate and would be developed at such time as the trail development moves forward. Appendix A includes the detailed design and construction costs, including all assumptions and calculations.

Table 5-2. Summary of Opinion of Probable Construction and Design Costs

Segment No. and Location		Length of Trail	Option 1 Total Cost	Option 2 Total Cost
A	Memorial Drive/Brookline Street Intersection to Massachusetts Avenue	4560	$ 3,053,385	$ 6,623,735
B	Massachusetts Avenue to Main Street	1425	$ 1,441,663	$ 2,755,835
C	Main Street to Broadway	740	$ 600,243	$ 600,243
D	Broadway to Binney Street	730	$ 505,980	$ 981,346
E	Binney Street to Cambridge Street	1810	$ 1,416,836	$ 3,032,597
F	Cambridge Street to Gore Street	510	$ 847,784	$ 1,701,574
	GRAND TOTAL	**9775 LF**	**$ 7,865,892**	**$ 15,695,330**

6. MANAGEMENT

A multi-use trail is a unique public facility because it blends two distinct purposes. On one hand, it is a non-motorized transportation corridor that in many respects must be managed like a street to assure user safety; on the other hand, it is also a greenway serving a variety of recreational user groups. Multi-use trails must also co-exist with property owners adjacent to the corridor, whose interests can be quite different from that of the trail users. Managing such a facility poses a unique challenge to the jurisdiction(s) owning it. For trails located on or adjacent to active rail lines, the need for effective management is significantly magnified.

Given the current active status of the Grand Junction Railroad, the path would be considered a rail-with-trail (RWT), defined as a multi-use trail located on or directly adjacent to an active railroad line (as opposed to a rail-to-trail, located on an abandoned rail line). For most such facilities, the development of a management plan represents a substantial commitment not only to the public, but also to the owner and/or operator of the rail line. With proper management practices in place, the trail may improve pre-existing conditions of trespass and conflict with rail operations.

The Grand Junction Trail would be considered a joint or "shared-use" facility, defined as a paved trail open to the general public for recreation and non-motorized transportation purposes in a corridor that primarily serves other transportation or utility functions. Virtually all paved multi-use trails in the United States are shared-use facilities between the general public and maintenance vehicles. Trails require their own maintenance, emergency access, and security vehicles. Although the Grand Junction Railroad is the most obvious shared use within the corridor, the trail would also be shared with existing utilities such as water, sewer, and electrical lines, as well as with maintenance vehicles.

The presence of the active rail line will be a dominant factor in the management and maintenance of the Grand Junction Trail. A RWT must be managed, operated, and maintained in a way that will a) protect the adjacent railroad infrastructure and operators; b) minimize costs to the railroad and to the trail managing entity; and c) maximize the enjoyment and safety of the public.

Responsibilities of the City of Cambridge

It generally takes coordination and cooperation between different agencies and/or different jurisdictions to successfully operate and maintain a trail. The following represents the major responsibilities of a trail management agency:

- Overall coordination and guidance during trail development
- Organize, coordinate and implement the trail operations plan
- Establish trail user regulations
- Develop and implement a maintenance plan and assure adequate funding
- Monitor security/safety of the trail through routine inspections
- Oversee major maintenance and rehabilitation efforts
- Manage issues that may arise with properties abutting the trail corridor
- Act as the chief trail spokesperson with the public, including elected officials, and respond to the issues and concerns raised by trail users
- Preserve the linear integrity of the corridor and set the policy on non-trail uses of the corridor

Design Management

It is helpful to adhere to established standards in trail design, signage, and maintenance. There are widely accepted standards or guidelines, such as the AASHTO Guide for the Development of Bicycle Facilities. Other practical measures include:

- Post warning signs for known hazards that are not easily eliminated
- Post and enforce trail regulations
- Enact a trail maintenance plan and maintain accurate records
- Maintain the trail to the level defined in the maintenance plan
- Inspect the trail regularly for hazards
- Promptly evaluate and address hazards and maintenance problems reported by trail users
- Ensure that there is adequate emergency access to the trail

These common sense precautions are indicative of good faith and responsible stewardship of the trail facility.

Operating the Grand Junction Trail - General Principles

The operation of the Grand Junction Trail will be as important as its design, and will have a large impact on how the public perceives the trail as well as the agency that manages it. Operating a trail is

an on-going process that will require adjustments, since accumulated experience will dictate what does and does not work.

Coordination of Operating Responsibilities and Procedures

The first step for a trail manager is determining which agency, department, organization or person will be responsible for each of the activities involved in operating a trail. That means working with maintenance staff to determine a maintenance schedule and perform routine trail surface cleaning, working with the traffic operations division for sign replacement and intersection traffic control; and working with the police and fire departments for developing emergency response procedures. It means thinking about all the ways a trail interacts with the environment around it, and trying to anticipate in advance all the problems that may arise, and who would address them. In many cases, formal agreements between departments will be needed to assign responsibilities and determine who is responsible for which costs.

Developing Trail Use Regulations

The purpose of trail regulations is to promote user safety and enhance the enjoyment of all users. It is imperative that before the trail is opened, trail use regulations are developed and posted at trailheads and key access points. Trail maps and informational materials might include these regulations as well. Establishing that the trail facility is a regulated traffic environment just like other public rights of way is critical for compliance, and often results in a facility requiring minimal enforcement. Be sure to have an attorney review the trail regulations for consistency with existing ordinances and enforceability. In some locations, it may be necessary to pass additional ordinances to implement trail regulations.

Below is a sample of the most common items that should be covered in trail regulations:

- Hours of use
- Motorized vehicles, other than power-assisted wheelchairs, are prohibited
- Keep to the right except when passing
- Yield to on-coming traffic when passing
- Bicyclists yield to pedestrians
- Give a vocal warning when passing
- Pets must always be on short leashes
- Travel no more than two abreast
- Alcoholic beverages are not permitted on the trail
- Do not wander off of trail onto adjacent properties
- Do not stand in middle of trail when stopped
- Speed limit

7. LEGISLATION, LIABILITY, AND INSURANCE

Liability is an important area of concern in virtually all RWT projects, and the Grand Junction Trail is no exception. In the context of the Grand Junction Trail, liability refers to the obligation of the trail operator or owner to pay or otherwise compensate a person who is harmed through some fault of the trail operator or railroad. A recent nationwide study of RWTs, Rails-with-Trails: Lessons Learned (2002) provides much guidance concerning the limits of liability and ensuring user safety.

The Grand Junction Trail would be considered a shared-use corridor, and the relationship of the parties in a shared-use corridor will be influenced by which entity holds the dominant property interest. For many shared-use corridors it is the trail that is the incidental use and must take into consideration the interests of the primary user. This is true of the Grand Junction Trail, as the primary user of the rail corridor is CSX. In addition, there are other existing uses of the corridor, such as service access to MIT buildings, which need to be considered.

In addition to CSX and MIT, other landholders include the City and several individuals and companies. This is an atypical situation, as most RWTs are owned by one property owner, such as a railroad or a state agency. For the Grand Junction, the question of ownership transfer or acquisition of an easement with all the property owners presents a distinct challenge. To maintain greater control on use and operation of shared physical space, typically a license or lease agreement is negotiated detailing the development and operation of the trail. This is discussed in greater detail later in this chapter.

It is important to recognize the potential risks associated with human activity near moving trains. Given the possibility of an accident, however remote, it is understandable that primary property owners will want to shield themselves as best as possible from lawsuits.

Overview of Concerns

These are the likely liability concerns about the intentional location of the trail near or on the active railroad corridor:

- The concern that the trail users might not be considered trespassers if CSX or MIT invites and permits trail use within a portion of their right-of-way, and if that were the case, the concern that the railroad or institution might therefore incur a higher duty of care to trail users than they would otherwise owe to persons trespassing on their corridor.

- The concern that incidents of trespassing might occur with greater frequency due to the proximity of a trail.

- The concern that trail users might be injured by railroad or MIT activities, such as an object falling or protruding from a train or from accidental exposure to hazardous materials.

- The concern that injured trail users might sue CSX or MIT even if the injury is unrelated to railroad operations.

- Concerns regarding the safety and security implications of creating a paved path with public access adjacent to a nuclear reactor (especially for MIT).

Definitions and Laws

As the owners and occupiers of their rights-of-way, railroads and property owners have legal duties and responsibilities to persons both on and off their premises. The property owners have a duty to exercise reasonable care on their premises to avoid an unreasonable risk of harm to others on adjacent properties Railroads may potentially be found liable if the use of their right-of-way creates an unreasonable risk to persons on an adjacent property such as through derailments or objects falling off the trains.

In most states, the duty of care owed to persons who enter another's property depends on whether the injured person is considered a trespasser, a licensee, or an invitee. A trespasser is a person who enters or remains upon land in possession of another without a privilege to do so, created by the possessor's consent or otherwise. A licensee or invitee is a person on the owner's land with the owner's permission, express or implied. Trespassers are due a lesser duty of care than invitees and licensees. In Massachusetts, property owners owe no special duty of care to persons trespassing on their premises, other than to refrain from intentional, harmful, or reckless acts.

Unique characteristics of the Grand Junction Trail that may affect the extent to which liability is potentially enlarged include:

- Ownership of land by multiple parties

- The narrow ROW of the corridor in certain segments

- The possible need to cross the railroad tracks in one or more places

- The possible co-location of the Urban Ring (MBTA) within the ROW

Available Legal Protections

Potentially offsetting some or all of a railroad's increased liability attributable to a RWT are the State-enacted Recreational Use Statutes (RUSs). All 50 states have RUSs, which provide protection to landowners who allow the public to use their land for recreational purposes. A person injured on land made available to the public for recreational use must prove that the landowner deliberately intended to harm him or her. States created RUSs to encourage landowners to make their land available for

public recreation by limiting their liability provided they do not charge a fee. Railroad companies and institutions that agree to an RWT on their property would have limited liability due to these statutes.

In Massachusetts the following laws and statutes apply:

Recreational Use Statues (RUS)	Trail, Rails-to-Trails Program, Recreational Trails System, or Similar Statute	Government Tort Liability Act	Railroad Fencing Laws
Massachusetts General Laws Ann. Ch. 21 § 17C	Chapter 82 Section 35A	Mass. Ann. Laws Ch 258, § 1 et seq. Tort Claims Act	Mass. Gen. Laws Ann. Ch. 160, § 93

The General Laws of Massachusetts, Chapter 21, Section 17 covers:

Public use of land for recreational, conservation, scientific educational and other purposes; landowner's liability limited; exception.

Section 17C. (a) Any person having an interest in land including the structures, buildings, and equipment attached to the land, including without limitation, wetlands, rivers, streams, ponds, lakes, and other bodies of water, who lawfully permits the public to use such land for recreational, conservation, scientific, educational, environmental, ecological, research, religious, or charitable purposes without imposing a charge or fee therefore, or who leases such land for said purposes to the commonwealth or any political subdivision thereof or to any nonprofit corporation, trust or association, shall not be liable for personal injuries or property damage sustained by such members of the public, including without limitation a minor, while on said land in the absence of willful, wanton, or reckless conduct by such person. Such permission shall not confer upon any member of the public using said land, including without limitation a minor, the status of an invitee or licensee to whom any duty would be owed by said person.

(b) The liability of any person who imposes a charge or fee for the use of his land by the public for the purposes described in subsection (a) shall not be limited by any provision of this section. The term "person" as used in this section shall be deemed to include the person having an interest in the land, his agent, manager, or licensee and shall include without limitation, any governmental body, agency or instrumentality, nonprofit corporation, trust or association, and any director, officer, trustee, member, employee or agent thereof. A contribution or other voluntary payment not required to be made to use such land shall not be considered a charge or fee within the meaning of this section.

Chapter 21, Section 17 of the General Laws of Massachusetts contains very specific language regarding the legal positions of landowners and their responsibilities towards public users of the land. The statute indicates that **a property owner, that has an interest in the land who lawfully permits the use of the land by the public is not liable for any personal injury or property damage suffered by the user, as long as the property owner did nothing to intentionally harm the user. Furthermore,**

the statue expressly limits the status of any member of the public by denying them the rights of either an invitee or licensee.

The General Laws of Massachusetts, Chapter 82, Section 35A:

Section 35A. The board or officers authorized to lay out highways or town ways may lay out, construct and maintain rail trails under the laws relative to the laying out, construction and maintenance of public ways. For purposes of this section, a rail trail shall mean property converted from the former use as a railroad right-of-way to a use as a publicly-owned, improved and maintained corridor for bicycle, pedestrian and other non-motorized public transportation, recreation and associated purposes. Rail trails may be laid out on property a city or town has acquired by fee, easement, lease, license or otherwise and may be subject to a reversion allowing the railroad company or authority to reclaim the property for rail purposes upon written notice. The owner of such reversion shall be exempt from liability for any claims associated with use of any such rail trail including claims for damages that may arise under section 15 of chapter 84 and section 38 of chapter 161A.

Liability Exposure Reduction Options

Besides the federally mandated RUSs, there are additional available legal protections that reduce risk for adjacent property owners on RWT projects. Table 7-1 lists the options for additional measures.

Table 7-1. Liability Protections

OPTIONS	INTENT
Trail or rail-with-trail State statute	Create state legislation that limits liability
Trespassing legislation	Creates state legislation that specifically prohibits trail users from going onto railroad property outside of the trail
Insurance	
Transfer of ownership	The City enjoys additional limitations of liability for injuries occurring on City-owned property.

Property Control

As noted earlier, the relationship of the parties in a shared-use corridor will be driven to a great extent by which entity holds the dominant property interest. The type of property control influences both the ease of implementing the project and the liability burden. There are three types of property arrangement: purchases, easement, and licenses.

Acquisition

To accommodate the concerns of property owners with respect to the location of a trail in an active right-of-way, the City of Cambridge could look to own the rail corridor itself. This internalizes the liability and coordination efforts. The City of Cambridge is treated differently from either CSX or other property owners due to its unique status as a sovereign entity. This option transfers basic liability to the City and would give the City the authority to locate the trail in the corridor. This was a

successful strategy for the City of Portland's Springwater on the Willamette Trail, for which the regional government, Metro, purchased the railroad corridor from a utility.

Easements

In most instances, full ownership acquisition is not necessary for trail development, and, in many cases, is not really an option. Easements, which come in many forms, typically are acquired when the landowner is willing to forego use of the property and development rights (or, if zoning permits, transfer the development rights) for an extended period. The landowner retains title to the land while relinquishing most of the day-to-day management of the property. The trail manager gets sufficient control for trail purposes. The easement is attached to the property title, so the easement survives property transfer. Table 7-2 provides an overview of easement agreement issues.

Table 7-2. Easement Agreement

A model easement agreement should:
Guarantee exclusive use or uses compatible with RWT's activities.
Be granted in perpetuity.
Include air rights if there is any possible need for a structure.
Broadly define purpose of the easement and identify all conceivable activities, uses, invitees, and vehicular types allowed to avoid any need to renegotiate with fee interest owner in future.
State that all structures and fixtures installed as part of a trail are property of grantee.
Include subsurface rights for use by utility franchises.

It is also understood that major landowners – in this case, MIT and CSX primarily – would want an easement agreement to address issues on their side. Through cooperative negotiation, the following issues should be addressed in an easement agreement:

- Access needs related to maintenance, etc.
- Trail management plan
- Future improvements or modifications to the trail

Licenses

A license is usually a fixed-term agreement that provides limited rights to the licensee for use of the property. Typically, these are employed in situations when the property cannot be sold (e.g. a publicly-owned, active electrical utility corridor), or the owner wants to retain use of and everyday control over the property. The trail management authority obtains permission to build and operate a trail. But it will have little control over the property, and may be subject to some stringent requirements that complicate trail development and operation. Table 7-3 provides an example of model license agreement language.

Table 7-3. License Agreement

A model license agreement should:
Provide an acceptable term length with an option to renew.
Identify all conceivable activities, uses, invitees, and vehicular types.
Provide clarity on maintenance responsibilities.
Specify limits on other uses of license property.

As with easement agreements, property owners would want a license agreement to address issues on their side. Through cooperative negotiation, the following issues should be addressed in a license agreement:

- Access needs related to maintenance, etc.
- Trail management plan
- Future improvements or modifications to the trail

CSX

CSX has entered into agreements with local jurisdictions in the past on at least two occasions:

- Three Rivers Heritage Trail (Pittsburgh, PA) – CSX was concerned about liability and trespassing during the negotiations for this trail. CSX stipulated a number of design requirements as part of the agreement to grant right-of-way
- West Orange Trail (Winter Garden, FL) – CSX requested design approval before granting an easement for trail construction.

Both of these trails are urban trails similar to the Grand Junction Trail, with trail widths of 10-14' and a distance of 5-25' from trail to the track centerline. CSX operates freight rail in both corridors with minimal frequency.

Risk Reduction

Visible signage, the use of physical barriers (such as fences, walls, vegetation, grade differences, and ditches) and good design are prudent liability protection strategies, as was explained in Chapter 4. Trail users should be warned at the trailhead and at any other entrances to stay off the railroad tracks, particularly if there are no physical barriers between the trail and the rail corridor. If the RWT is clearly designed to indicate that the railroad corridor is separate from the trail, trail users injured while within the railroad corridor or on the railroad tracks should be considered trespassers to which no special duty of care is owed. A well-designed RWT can actually reduce trespassing by channelizing pedestrian crossings to safe locations or by providing separation or security. A well-designed RWT should have the effect of reducing both trespassing, as well as risk of being held responsible for injuries sustained by trespassers.

Summary

Successful trails can be planned and operated in relatively narrow ROW corridors. With the agreement of various landowners in the Grand Junction Corridor, a shared use path could be developed in this corridor. The elements that need to be carefully considered and planned are:

- Ownership: The City acquires land or an easement.
- Management: The City manages the trail.
- Design: Well-designed RWTs reduce liability exposure, trespassing, vandalism, and other impacts to the railroad and private property owners. Appropriate separation technique, setback distance, crossing design, and other elements all contribute to an effectively designed, user-friendly trail.
- Acquire the properties if possible or negotiate easement agreements with the relevant property owners. Ensure that the property owners are well aware of the strong Massachusetts laws limiting their exposure to liability.

APPENDIX A: OPINION OF PROBABLE COST

The following is a list of assumptions used to develop the opinion of probable construction costs:

Option 1 – Grand Junction Rail with Multi-purpose Trail

General - for all Segments:

- Quantities are based on conceptual study sketches and brief field visits and will need to be verified during the design stage
- Trail is 12 ft wide with 3 ft shoulders on each side
- Trail pavement structure includes 2" top course, 4" binder course, and 6" compacted gravel borrow subbase
- Gravel Borrow extends to the limits of the proposed shoulders
- Slope off shoulders are 4 (Horizontal) : 1 (Vertical)
- No excavated material will be reused
- Entire width of new trail section needs to be cleared and grubbed due to overgrowth
- Using unit price of $68 for Grigliato Fence (Note: cost for black chain link fence is approximately $35 per lf)
- Number of trees has been assumed
- Type and size of new trees has not been determined
- Number of new trees proposed equals number of trees assumed to be removed
- Electric lighting poles have a maximum height of 15 feet and are spaced 75 feet apart
- Electric handholes are spaced every 150 feet and electric manholes are spaced every 100 feet
- Four control box/load centers have been assumed to be located in Segment 1, 2, 4 and 6
- Emergency Call Box item includes a 12'x12'x6' NEMA Type 4 Box, Blue Warning Beacon, 25 ft conduit and 25 ft wiring
- Spacing of Emergency Call Boxes has been assumed at 500 feet - the actual locations will need to be determined during the design phase
- Land acquisitions are NOT included
- Design phase to start July 2006, completed project bid in July 2007, awarded to Contractor in October 2007, construction to begin April 2008
- Segments 2, 3, 4 & 6 estimated at a 6 month construction period; Segment 5 at 1 year; Segment 1 at 2 years
- Inflation rate is calculated at halfway point of estimate construction -- Segment 6 = 39 mo = 36 months to start + 3 mo to halfway point of construction

Segment 1:

- Trail is located to the west of the RR tracks
- Quarter of excavated material is old RR track to be removed

Segment 2:

- Trail is located to the west of the RR tracks

Segment 3:

- Trail will be located adjacent to sidewalk NOT next to the RR tracks
- Utility manholes located in the 2-3 foot "hole" will be removed and replaced with "deep" manholes
- Relocating playground equipment is not included. Only hedge and fence removal is included
- Trail crossing will be located at the Main Street/Vassar Street/G.G. Way intersection
- New fencing is NOT needed

Segment 4:

- Trail will be located adjacent to sidewalk NOT next to the RR tracks
- Trail elevation matches existing elevation for approximately 600 feet
- Trail then slopes downhill to meet elevation of tracks - change of elevation assumed to be 2 feet

Segment 5:

- Relocate fencing to allow enough room for trail in between the fence and the rail
- Trail is located to the west of the existing RR tracks
- Trail elevation matches existing elevation

Segment 6:

- Trail is located on the east side of the RR tracks
- Ground looks slightly sloped and have assumed excavation to be 10 inches deep
- Pedestrian Crossing Signal Equipment includes relocating the existing controller box, warning arms, all necessary wiring and pavement markings

Cambridge Street Crossing:

- Install new pedestrian (trail) signal for crossing over Cambridge Street
- Eliminate the existing pedestrian signal (to be combined with new trail crossing)
- Relocate both RR signal poles
- Relocate one ornamental street light
- RR signal relocations include relocating the existing posts, warning arms, signs, lights, all necessary wiring and pavement markings

Binney Street Crossing:

At this point, it is assumed that a signalized crossing is not needed at this location. However, given that changes will be made to the nearby intersection of Binney Street and Fulkerson Street in the form of a new signal, it may be that future analysis will recommend a signal here. This estimate reflects the cost as an option.

- RR signal poles are okay where they are
- New pedestrian signal to be installed for trail crossing Binney Street
- Interconnection of pedestrian signal and RR signal
- Interconnection of pedestrian signal and new signal at Binney/Fulkerson
- Relocate signal control box

Broadway Crossing:

- Trail will cross at existing crosswalk
- Relocate two signal control boxes
- Relocate red utility box
- Utility structure to be rebuilt/adjusted

Main Street Crossing:

- Relocate one RR signal pole
- Install warning signs

Massachusetts Avenue Crossing:

- Traffic counts and analysis has been completed by others
- Interconnect the two traffic signals with the trail crossing signal
- Interconnect the trail crossing signal with the RR crossing warning signal
- Location of RR signal poles are okay where they are
- The controller boxes at the two traffic signals will be replaced
- Install new trail crossing signal
- New conduit will be installed between all signals
- New sidewalk will be installed where conduit trenches disturbed exisitng sidewalks

Pedestrian Crossing over Tracks - Main Street to Massachusetts Avenue:

- Locations of RR signal warning poles do not need to be relocated

Pedestrian Crossing over Tracks - Massachusetts Avenue to Memorial Drive/Brookline Street Intersection:

- Locations of RR signal warning poles do not need to be relocated

<u>Option 2 – Grand Junction Rail with Multi-purpose Trail and One-Way BRT</u>

General - for all Segments:

- All assumptions made for Option 1 also apply to Option 2 unless noted below
- Bus route is one-way
- Cross section includes 3' shoulder +12' trail + 2' barrier + 11' bus lane + fence + 17' rail lane
- Busway and railway are accommodated in 28’ width and divided by fence
- Materials for construction of the bus route were not calculated (including barrier)
- Land related costs are not included

Segment 1 & 2:

- Existing rail to be relocated to the south to allow room for bus route
- See Track Relocation Breakdown for assumptions for track work (as completed by Edwards & Kelcey)

Segment 4:

- Relocate approximately 500 ft of RR tracks to the west

Segment 5:

- Relocate RR tracks to the west
- Trail is located to the east of the existing RR tracks

Segment 6:

- Rail to be relocated to the east side of the ROW so the trail can be built on the west side of the RR tracks

The following pages include the breakdown of the Opinion of Probable Construction and Design Costs for each of the segments in each of the Options. The breakdown shows a quantity and unit price for each item that would be used during construction by segments. The chart is subtotaled and detailed with the associated costs of construction. The construction cost is then totaled. The chart also includes an estimated cost for design and engineering oversight during construction with a grand total cost for the entire design and construction of the trail.

CITY OF CAMBRIDGE - Option 1

Grand Junction Rail with Multi-Purpose Trail

Opinion of Probable Construction Costs

			TRAIL QUANTITIES										UTILITY QUANTITIES														
Segment No.	Street	Length of Trail	Clearing and Grubbing	Excavation	Remove and Dispose of Unused RR Track	Gravel Borrow Subbase	Hot Mix Asphalt Top Course	Hot Mix Asphalt Binder Course	Fence Remove and Reset	6 ft Fence	Fence Removed and Stacked	4 Inch Yellow Pavement Markings (Thermoplastic)	New Trail Crossing Ped Signal and coordiante with Exist	New Pedestrain Signal at Trail Crossing	Trail Crossing to be Included in Exisitng Traffic Signal	Relocate One Side of Exist Signal Equipment at Trail	New Signal Equipment for Trail Crossing Street and	Upgrade Ped Signals at Existing Traffic Signal	Hydrant Remove and Reset	Lighting Poles and Luminaires	Electirc Conduit for Lighting System	Electric Wiring for Lighting System	Electric Handholes for Lighting System	Precast Electric Manholes for Lighting System	Electric Control Boxes / Load Center for Lighting	Utility Manhole Removal	Utility Manhole - Deep	Utility Structures Adjusted with Concrete Slab	Emergency Call Box
	Units		A	CY	LF	CY	TON	TON	LF	LF	LF	LF	LS	LS	LS	LS	LS	LS	EA	LS	LF	LF	EA	EA	EA	EA	EA	LS	EA
	Cost per Unit	LF	$5,000	$20	$50	$30	$65	$60	$25	$68	$10	$3	$135,000	$110,000	$8,500	$15,500	$140,000	$5,000	$4,100	$4,400	$36	$3	$600	$2,700	$60,000	$750	$5,500	$10,000	$1,800
1	**Memorial Drive/Brookline Street Intersection to Massachusetts Avenue**																												
1	Memorial Drive/Brookline St Int to Path Extention	750	0.4	420	0	340	115	225	0	0	0	750	0	0	0	0	0	1	1	10	830	830	5	5	0	0	0	0	1
1	Path Extention to Massachusetts Avenue	3810	1.9	1940	1500	1560	560	1140	300	3810	0	3810	0	0	0	0	0	0	0	51	3500	3500	26	26	1	0	0	0	7
	Sub-Total	**4,560**	**2.3**	**2360**	**1500**	**1900**	**675**	**1365**	**300**	**3810**	**0**	**4560**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**61**	**4330**	**4330**	**31**	**31**	**1**	**0**	**0**	**0**	**8**
2	**Massachusetts Avenue to Main Street**	1425	0.1	700	0	860	220	430	1425	1425	0	1425	0	0	0	0	0	0	0	19	1570	1570	10	2	1	0	0	0	2
2	Massachusetts Avenue Crossing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	**1,425**	**0.1**	**700**	**0**	**860**	**220**	**430**	**1425**	**1425**	**0**	**1425**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**19**	**1570**	**1570**	**10**	**2**	**1**	**0**	**0**	**0**	**2**
3	**Main Street to Broadway**	740	0.05	840	0	380	110	230	150	0	150	740	0	0	0	0	0	0	0	10	820	820	5	1	0	2	2	0	1
3	Main Street Crossing		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	**740**	**0.05**	**840**	**0**	**380**	**110**	**230**	**150**	**0**	**150**	**740**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**10**	**820**	**820**	**5**	**1**	**0**	**2**	**2**	**0**	**1**
4	**Broadway to Binney Street**	730	0.05	430	0	400	110	220	150	0	0	730	0	0	0	0	0	0	0	10	800	800	5	1	1	0	0	1	1
4	Broadway Crossing		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	**730**	**0.05**	**430**	**0**	**400**	**110**	**220**	**150**	**0**	**0**	**730**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**10**	**800**	**800**	**5**	**1**	**1**	**0**	**0**	**1**	**1**
5	**Binney Street to Cambridge Street**	1810	0.5	1350	0	760	270	550	1810	1810	0	1810	0	0	0	0	0	0	0	24	2000	2000	12	2	0	0	0	0	4
5	Binney Street Crossing		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	**1,810**	**0.5**	**1350**	**0**	**760**	**270**	**550**	**1810**	**1810**	**0**	**1810**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**24**	**2000**	**2000**	**12**	**2**	**0**	**0**	**0**	**0**	**4**
6	**Cambridge Street to Gore Street**	510	0.25	300	0	220	80	160	250	510	0	510	0	0	0	0	0	0	0	7	560	560	4	1	1	0	0	0	1
6	Cambridge Street Crossing		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	**510**	**0.25**	**300**	**0**	**220**	**80**	**160**	**250**	**510**	**0**	**510**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**560**	**560**	**4**	**1**	**1**	**0**	**0**	**0**	**1**
	GRAND TOTAL	**9,775 LF**	**3.25 A**	**5980 CY**	**1500 LF**	**4520 CY**	**1465 TON**	**2955 TON**	**4085 LF**	**7555 LF**	**150 LF**	**9775 LF**	**1 LS**	**1 LS**	**1 LS**	**1 LS**	**1 LS**	**1 LS**	**1 EA**	**131 LS**	**10080 LF**	**10080 LF**	**67 EA**	**38 EA**	**4 EA**	**2 EA**	**2 EA**	**1 LS**	**17 EA**

CITY OF CAMBRIDGE - Option 1

Grand Junction Rail with Multi-Purpose Trail

Opinion of Probable Construction Costs

		LANDSCAPING QUANTITIES						SUB-TOTALS										
Segment No.	Street	Loam Borrow	Seeding	Tree Protection	Tree Removal	Hedge/Shrub Removal	Tree	Trail Quantities **(A)**	Utility Quantities **(B)**	Landscaping Quantities **(C)**	Trail, Utility, and Landscaping Sub-total **(A+B+C) = (D)**	Soil and Watse Management **(E) = Subtotal (D) * 10.5%**	Base Construction Sub-Total **(D+E) = (F)**	Mobilization **(G) = Subtotal (F) * 5%**	Base Construction Sub-Total **(F+G) = (H)**	Fixed Factor **(I)**	Construction Contingency **(H*I) = (J)**	Base Construction Total with Contingency **(H+J) = (K)**	Fixed Factor **(L)**
	Units	CY	SY	EA	EA	LF	EA												
	Cost per Unit	$35	$1	$100	$400	$100	$800	$	$	$	$	$	$	$	$	%	$	$	%
1	**Memorial Drive/Brookline Street Intersection to Massachusetts Avenue**																		
1	Memorial Drive/Brookline St Int to Path Extention	130	950	4	0	0	0	$ 43,825	$ 103,355	$ 5,900	$ 153,080	$ 16,073	$ 169,153	$ 8,458	$ 177,611	40%	$ 71,044	$ 248,655	5%
1	Path Extention to Massachusetts Avenue	560	4240	4	0	0	0	$ 552,910	$ 517,550	$ 24,240	$ 1,094,700	$ 114,944	$ 1,209,644	$ 60,482	$ 1,270,126	40%	$ 508,050	$ 1,778,176	5%
	Sub-Total	**690**	**5190**	**8**	**0**	**0**	**0**	**$ 596,735**	**$ 620,905**	**$ 30,140**	**$ 1,247,780**	**$ 131,017**	**$ 1,378,797**	**$ 68,940**	**$ 1,447,737**		**$ 579,095**	**$ 2,026,831**	
2	**Massachusetts Avenue to Main Street**	310	2220	0	0	0	0	$ 217,200	$ 219,045	$ 13,070	$ 449,315	$ 47,178	$ 496,493	$ 24,825	$ 521,318	40%	$ 208,527	$ 729,845	5%
2	Massachusetts Avenue Crossing	0	0	0	0	0	0	$ -	$ 140,000	$ -	$ 140,000	$ 14,700	$ 154,700	$ 7,735	$ 162,435	40%	$ 64,974	$ 227,409	5%
	Sub-Total	**310**	**2220**	**0**	**0**	**0**	**0**	**$ 217,200**	**$ 359,045**	**$ 13,070**	**$ 589,315**	**$ 61,878**	**$ 651,193**	**$ 32,560**	**$ 683,753**		**$ 273,501**	**$ 957,254**	
3	**Main Street to Broadway**	160	1160	12	45	150	50	$ 56,870	$ 95,570	$ 80,960	$ 233,400	$ 24,507	$ 257,907	$ 12,895	$ 270,802	40%	$ 108,321	$ 379,123	5%
3	Main Street Crossing	0	0	0	0	0	0	$ -	$ 15,500	$ -	$ 15,500	$ 1,628	$ 17,128	$ 856	$ 17,984	40%	$ 7,194	$ 25,177	5%
												$ -							
	Sub-Total	**160**	**1160**	**12**	**45**	**150**	**50**	**$ 56,870**	**$ 111,070**	**$ 80,960**	**$ 248,900**	**$ 26,135**	**$ 275,035**	**$ 13,752**	**$ 288,786**		**$ 115,514**	**$ 404,301**	
4	**Broadway to Binney Street**	80	540	4	1	0	1	$ 47,140	$ 152,300	$ 4,940	$ 204,380	$ 21,460	$ 225,840	$ 11,292	$ 237,132	40%	$ 94,853	$ 331,985	5%
4	Broadway Crossing	0	0	0	0	0	0	$ -	$ 8,500	$ -	$ 8,500	$ 893	$ 9,393	$ 470	$ 9,862	40%	$ 3,945	$ 13,807	5%
	Sub-Total	**80**	**540**	**4**	**1**	**0**	**1**	**$ 47,140**	**$ 160,800**	**$ 4,940**	**$ 212,880**	**$ 22,352**	**$ 235,232**	**$ 11,762**	**$ 246,994**		**$ 98,798**	**$ 345,792**	
5	**Binney Street to Cambridge Street**	230	1610	12	8	0	8	$ 276,610	$ 202,400	$ 20,460	$ 499,470	$ 52,444	$ 551,914	$ 27,596	$ 579,510	40%	$ 231,804	$ 811,314	5%
5	Binney Street Crossing	0	0	0	0	0	0	$ -	$ 110,000	$ -	$ 110,000	$ 11,550	$ 121,550	$ 6,078	$ 127,628	40%	$ 51,051	$ 178,679	5%
	Sub-Total	**230**	**1610**	**12**	**8**	**0**	**8**	**$ 276,610**	**$ 312,400**	**$ 20,460**	**$ 609,470**	**$ 63,994**	**$ 673,464**	**$ 33,673**	**$ 707,138**		**$ 282,855**	**$ 989,993**	
6	**Cambridge Street to Gore Street**	65	460	4	0	0	0	$ 71,110	$ 119,260	$ 3,135	$ 193,505	$ 20,318	$ 213,823	$ 10,691	$ 224,514	40%	$ 89,806	$ 314,320	5%
6	Cambridge Street Crossing	0	0	0	0	0	0	$ -	$ 135,000	$ -	$ 135,000	$ 14,175	$ 149,175	$ 7,459	$ 156,634	40%	$ 62,654	$ 314,320	5%
	Sub-Total	**65**	**460**	**4**	**0**	**0**	**0**	**$ 71,110**	**$ 254,260**	**$ 3,135**	**$ 328,505**	**$ 34,493**	**$ 362,998**	**$ 18,150**	**$ 381,148**		**$ 152,459**	**$ 628,640**	
	GRAND TOTAL	**1535 CY**	**11180 SY**	**40 EA**	**54 EA**	**150 LF**	**59 EA**	**$ 1,265,665**	**$ 1,818,480**	**$ 152,705**	**$ 3,236,850**	**$ 339,869**	**$ 3,576,719**	**$ 178,836**	**$ 3,755,555**		**$ 1,502,222**	**$ 5,352,810**	

CITY OF CAMBRIDGE - Option 1

Grand Junction Rail with Multi-Purpose Trail

Opinion of Probable Construction Costs

Segment No.	Street	Police Detail **(K*L) = (M)**	Base Construction Total with Contingency **(K+M) = (N)**	Inflation Rate 0.283% per month (fixed)	**Construction TOTAL (I+K+M) = (N)**	Design Fee (Assumed 10% of Total Construction Cost)	Construction Oversight Fee (Assumed 10% of Total Construction Cost)	**Design, Construction, and Construction Oversight TOTAL**
	Units Cost per Unit	$	$		**$**	$	$	**$**
1	**Memorial Drive/Brookline Street Intersection to Massachusetts Avenue**							
1	Memorial Drive/Brookline St Int to Path Extention	$ 3,552	$ 252,208	$ 59,955	**$ 312,163**	$ 31,216	$ 31,216	**$ 374,595**
1	Path Extention to Massachusetts Avenue	$ 25,403	$ 1,803,578	$ 428,747	**$ 2,232,325**	$ 223,233	$ 223,233	**$ 2,678,790**
	Sub-Total	**$ 28,955**	**$ 2,055,786**	**$ 488,701**	**$ 2,544,488**	**$ 254,449**	**$ 254,449**	**$ 3,053,385**
2	**Massachusetts Avenue to Main Street**	$ 36,492	$ 766,337	$ 149,643	**$ 915,980**	$ 91,598	$ 91,598	**$ 1,099,176**
2	Massachusetts Avenue Crossing	$ 11,370	$ 238,779	$ 46,626	**$ 285,406**	$ 28,541	$ 28,541	**$ 342,487**
	Sub-Total	**$ 47,863**	**$ 1,005,117**	**$ 196,269**	**$ 1,201,386**	**$ 120,139**	**$ 120,139**	**$ 1,441,663**
3	**Main Street to Broadway**	$ 18,956	$ 398,079	$ 70,974	**$ 469,053**	$ 46,905	$ 46,905	**$ 562,864**
3	Main Street Crossing	$ 1,259	$ 26,436	$ 4,713	**$ 31,150**	$ 3,115	$ 3,115	**$ 37,380**
	Sub-Total	**$ 20,215**	**$ 424,516**	**$ 75,687**	**$ 500,203**	**$ 50,020**	**$ 50,020**	**$ 600,243**
4	**Broadway to Binney Street**	$ 16,599	$ 348,584	$ 56,230	**$ 404,814**	$ 40,481	$ 40,481	**$ 485,777**
4	Broadway Crossing	$ 690	$ 14,497	$ 2,339	**$ 16,836**	$ 1,684	$ 1,684	**$ 20,203**
	Sub-Total	**$ 17,290**	**$ 363,081**	**$ 58,569**	**$ 421,650**	**$ 42,165**	**$ 42,165**	**$ 505,980**
5	**Binney Street to Cambridge Street**	$ 40,566	$ 851,880	$ 115,719	**$ 967,599**	$ 96,760	$ 96,760	**$ 1,161,119**
5	Binney Street Crossing	$ 8,934	$ 187,612	$ 25,485	**$ 213,098**	$ 21,310	$ 21,310	**$ 255,717**
	Sub-Total	**$ 49,500**	**$ 1,039,492**	**$ 141,205**	**$ 1,180,697**	**$ 118,070**	**$ 118,070**	**$ 1,416,836**
6	**Cambridge Street to Gore Street**	$ 4,490	$ 318,810	$ 35,187	**$ 353,997**	$ 35,400	$ 35,400	**$ 424,797**
6	Cambridge Street Crossing	$ 3,133	$ 317,453	$ 35,037	**$ 352,490**	$ 35,249	$ 35,249	**$ 422,988**
	Sub-Total	**$ 7,623**	**$ 636,263**	**$ 70,224**	**$ 706,487**	**$ 70,649**	**$ 70,649**	**$ 847,784**
	GRAND TOTAL	**$ 171,445**	**$ 5,524,255**	**$ 1,030,655**	**$ 6,554,910**	**$ 655,491**	**$ 655,491**	**$ 7,865,892**

CITY OF CAMBRIDGE - Option 1 - Grand Junction Rail w/ Multi-Purpose Trail
Opinion of Probable Construction Costs
Signal System Modification Breakdown

Trail Crossing	Item Descriptions	Unit	Quantity	Unit Cost	TOTAL
Memorial Drive at Reid Overpass and Cottage Farm Bridge					
	Upgrade ped signals at existing signal	LS	1	$5,000	$5,000
					$5,000
Massachusetts Avenue Crossing					
	The controller boxes at the two traffic signals will be replaced	EA	2	$10,000	$20,000
	Install new trail crossing signal	LS	1	$100,000	$100,000
	New interconnect conduit will be installed bewteen all signals	LS	1	$5,000	$5,000
	New sidewalk will be installed where conduit trenches disturbed exisitng sidewalks	LS	1	$15,000	$15,000
					$140,000
Main Street Crossing					
	Relocate one RR signal pole	LS	1	$15,000	$15,000
	Install warning signs	LS	1	$500	$500
					$15,500
Broadway Crossing					
	Relocate two signal control boxes	LS	1	$5,000	$5,000
	Relocate red utility box	LS	1	$1,500	$1,500
	Utility structure to be rebuilt/adjusted	LS	1	$2,000	$2,000
					$8,500
Binney Street Crossing (Included as an option only)					
	New ped signal to be installed for trail crossing Binney Street	LS	1	$100,000	$100,000
	Interconnection to future signal at Fulkerson/Binney Streets	LS	1	$5,000	$5,000
	Interconnection of ped signal and RR signal	LS	1	$5,000	$5,000
	Relocate signal control box	LS	1	$5,000	$5,000
					$115,000
Cambridge Street Crossing					
	Install new ped (trail) signal for crossing over Cambridge Street	LS	1	$100,000	$100,000
	Eliminate the existing ped signal (to be combnined with new trail crossing)	LS	1	$3,000	$2,000
	Relocate both RR signal poles	EA	2	$15,000	$30,000
	Relocate one ornamental street light	EA	1	$2,500	$3,000
					$135,000

CITY OF CAMBRIDGE - Option 2

Grand Junction Rail with Multi Purpose Trail and One-Way Urban Ring Bus Rapid Transit

Opinion of Probable Construction Costs

			TRAIL QUANTITIES											UTILITY QUANTITIES																
Segment No.	Street	Length of Trail	Clearing and Grubbing	Excavation	Remove and Dispose of Unused RR Track	Gravel Borrow Subbase	Hot Mix Asphalt Top Course	Hot Mix Asphalt Binder Course	Fence Remove and Reset	6 ft Fence	Fence Removed and Stacked	4 Inch Yellow Pavement Markings (Thermoplastic)	Relocate Main Rail Line and Siding	New Trail Crossing Ped Signal and coordiante with Exist	New Pedestrain Signal at Trail Crossing	Trail Crossing to be Included in Exisitng Traffic Signal	Relocate One Side of Exist Signal Equipment at Trail	New Signal Equipment for Trail Crossing Street and	Upgrade Ped Signals at Existing Traffic Signal	Hydrant Remove and Reset	Lighting Poles and Luminaires	Electirc Conduit for Lighting System	Electric Wiring for Lighting System	Electric Handholes for Lighting System	Precast Electric Manholes for Lighting System	Electric Control Boxes / Load Center for Lighting	Utility Manhole Removal	Utility Manhole - Deep	Utility Structures Adjusted with Concrete Slab	Emergency Call Box
	Units		A	CY	LF	CY	TON	TON	LF	LF	LF	LF	LF	LS	LS	LS	LS	LS	LS	EA	LS	LF	LF	EA	EA	EA	EA	EA	LS	EA
	Cost per Unit	LF	$5,000	$20	$50	$30	$65	$60	$25	$52	$10	$3	$400	$135,000	$110,000	$8,500	$15,500	$140,000	$5,000	$4,100	$4,400	$36	$3	$600	$2,700	$60,000	$750	$5,500	$10,000	$1,800
1	**Memorial Drive/Brookline Street Intersection to Massachusetts Avenue**																													
1	Memorial Drive/Brookline St Int to Path Extention	750	0.4	420	0	340	115	225	0	0	0	750	0	0	0	0	0	0	1	1	10	830	830	5	5	0	0	0	0	1
1	Path Extention to Massachusetts Avenue	3810	1.9	1940	1500	1560	560	1140	300	3810	0	3810	3800	0	0	0	0	0	0	0	51	3500	3500	26	26	1	0	0	0	7
	Sub-Total	**4,560**	**2.3**	**2360**	**1500**	**1900**	**675**	**1365**	**300**	**3810**	**0**	**4560**	**3800**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**61**	**4330**	**4330**	**31**	**31**	**1**	**0**	**0**	**0**	**8**
2	**Massachusetts Avenue to Main Street**	1425	0.1	700	0	860	220	430	1425	1425	0	1425	1400	0	0	0	0	0	0	0	19	1570	1570	10	2	1	0	0	0	2
2	Massachusetts Avenue Crossing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	**1,425**	**0.1**	**700**	**0**	**860**	**220**	**430**	**1425**	**1425**	**0**	**1425**	**1400**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**19**	**1570**	**1570**	**10**	**2**	**1**	**0**	**0**	**0**	**2**
3	**Main Street to Broadway**	740	0.05	840	0	380	110	230	150	0	150	740	0	0	0	0	0	0	0	0	10	820	820	5	1	0	2	2	0	1
3	Main Street Crossing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	**740**	**0.05**	**840**	**0**	**380**	**110**	**230**	**150**	**0**	**150**	**740**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**10**	**820**	**820**	**5**	**1**	**0**	**2**	**2**	**0**	**1**
4	**Broadway to Binney Street**	730	0.05	430	0	400	110	220	150	0	0	730	500	0	0	0	0	0	0	0	10	800	800	5	1	1	0	0	1	1
4	Broadway Crossing		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	**730**	**0.05**	**430**	**0**	**400**	**110**	**220**	**150**	**0**	**0**	**730**	**500**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**10**	**800**	**800**	**5**	**1**	**1**	**0**	**0**	**1**	**1**
5	**Binney Street to Cambridge Street**	1810	0.5	1350	0	760	270	550	1810	1810	0	1810	1810	0	0	0	0	0	0	0	24	2000	2000	12	2	0	0	0	0	4
5	Binney Street Crossing		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	**1,810**	**0.5**	**1350**	**0**	**760**	**270**	**550**	**1810**	**1810**	**0**	**1810**	**1810**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**24**	**2000**	**2000**	**12**	**2**	**0**	**0**	**0**	**0**	**4**
6	**Cambridge Street to Gore Street**	510	0.25	300	0	220	80	160	250	510	0	510	510	0	0	0	0	0	0	0	7	560	560	4	1	1	0	0	0	1
6	Cambridge Street Crossing		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	**510**	**0.25**	**300**	**0**	**220**	**80**	**160**	**250**	**510**	**0**	**510**	**510**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**560**	**560**	**4**	**1**	**1**	**0**	**0**	**0**	**1**
	GRAND TOTAL	**9,775 LF**	**3.25 A**	**5980 CY**	**1500 LF**	**4520 CY**	**1465 TON**	**2955 TON**	**4085 LF**	**7555 LF**	**150 LF**	**9775 LF**	**8020 LF**	**1 LS**	**1 LS**	**1 LS**	**1 LS**	**1 LS**	**1 LS**	**1 EA**	**131 LS**	**10080 LF**	**10080 LF**	**67 EA**	**38 EA**	**4 EA**	**2 EA**	**2 EA**	**1 LS**	**17 EA**

CITY OF CAMBRIDGE - Option 2

Grand Junction Rail with Multi Purpose Trail and One-Way Urban Ring Bus Rapid Transit

Opinion of Probable Construction Costs

		LANDSCAPING QUANTITIES						SUB-TOTALS												
Segment No.	Street	Loam Borrow	Seeding	Tree Protection	Tree Removal	Hedge/Shrub Removal	Tree	Trail Quantities **(A)**	Utility Quantities **(B)**	Landscaping Quantities **(C)**	Trail, Utility, and Landscaping Sub-total **(A+B+C) = (D)**	Soil and Watse Management **(E) = Subtotal (D) * 10.5%**	Base Construction Sub-Total **(D+E) = (F)**	Mobilization **(G) = Subtotal (F) * 5%**	Base Construction Sub-Total **(F+G) = (H)**	Fixed Factor **(I)**	Construction Contingency **(H*I) = (J)**	Base Construction Total with Contingency **(H+J) = (K)**	Fixed Factor **(L)**	Police Detail **(K*L) = (M)**
	Units	CY	SY	EA	EA	LF	EA													
	Cost per Unit	$35	$1	$100	$400	$100	$800	$	$	$	$	$	$	$	$	%	$	$	%	$
1	**Memorial Drive/Brookline Street Intersection to Massachusetts Avenue**																			
1	Memorial Drive/Brookline St Int to Path Extention	130	950	4	0	0	0	$ 43,825	$ 103,355	$ 5,900	$ 153,080	$ 16,073	$ 169,153	$ 8,458	$ 177,611	40%	$ 71,044	$ 248,655	5%	$ 3,552
1	Path Extention to Massachusetts Avenue	560	4240	4	0	0	0	$ 2,011,950	$ 517,550	$ 24,240	$ 2,553,740	$ 268,143	$ 2,821,883	$ 141,094	$ 2,962,977	40%	$ 1,185,191	$ 4,148,168	5%	$ 59,260
	Sub-Total	**690**	**5190**	**8**	**0**	**0**	**0**	**$ 2,055,775**	**$ 620,905**	**$ 30,140**	**$ 2,706,820**	**$ 284,216**	**$ 2,991,036**	**$ 149,552**	**$ 3,140,588**		**$ 1,256,235**	**$ 4,396,823**		**$ 62,812**
2	**Massachusetts Avenue to Main Street**	310	2220	0	0	0	0	$ 754,400	$ 219,045	$ 13,070	$ 986,515	$ 103,584	$ 1,090,099	$ 54,505	$ 1,144,604	40%	$ 457,842	$ 1,602,446	5%	$ 80,122
2	Massachusetts Avenue Crossing	0	0	0	0	0	0	$ -	$ 140,000	$ -	$ 140,000	$ 14,700	$ 154,700	$ 7,735	$ 162,435	40%	$ 64,974	$ 227,409	5%	$ 11,370
	Sub-Total	**310**	**2220**	**0**	**0**	**0**	**0**	**$ 754,400**	**$ 359,045**	**$ 13,070**	**$ 1,126,515**	**$ 118,284**	**$ 1,244,799**	**$ 62,240**	**$ 1,307,039**		**$ 522,816**	**$ 1,829,855**		**$ 91,493**
3	**Main Street to Broadway**	160	1160	12	45	150	50	$ 56,870	$ 95,570	$ 80,960	$ 233,400	$ 24,507	$ 257,907	$ 12,895	$ 270,802	40%	$ 108,321	$ 379,123	5%	$ 18,956
3	Main Street Crossing	0	0	0	0	0	0	$ -	$ 15,500	$ -	$ 15,500	$ 1,628	$ 17,128	$ 856	$ 17,984	40%	$ 7,194	$ 25,177	5%	$ 1,259
												$ -								
	Sub-Total	**160**	**1160**	**12**	**45**	**150**	**50**	**$ 56,870**	**$ 111,070**	**$ 80,960**	**$ 248,900**	**$ 26,135**	**$ 275,035**	**$ 13,752**	**$ 288,786**		**$ 115,514**	**$ 404,301**		**$ 20,215**
4	**Broadway to Binney Street**	80	540	4	1	0	1	$ 247,140	$ 152,300	$ 4,940	$ 404,380	$ 42,460	$ 446,840	$ 22,342	$ 469,182	40%	$ 187,673	$ 656,855	5%	$ 32,843
4	Broadway Crossing	0	0	0	0	0	0	$ -	$ 8,500	$ -	$ 8,500	$ 893	$ 9,393	$ 470	$ 9,862	40%	$ 3,945	$ 13,807	5%	$ 690
	Sub-Total	**80**	**540**	**4**	**1**	**0**	**1**	**$ 247,140**	**$ 160,800**	**$ 4,940**	**$ 412,880**	**$ 43,352**	**$ 456,232**	**$ 22,812**	**$ 479,044**		**$ 191,618**	**$ 670,662**		**$ 33,533**
5	**Binney Street to Cambridge Street**	230	1610	12	8	0	8	$ 971,650	$ 202,400	$ 20,460	$ 1,194,510	$ 125,424	$ 1,319,934	$ 65,997	$ 1,385,930	40%	$ 554,372	$ 1,940,302	5%	$ 97,015
5	Binney Street Crossing	0	0	0	0	0	0	$ -	$ 110,000	$ -	$ 110,000	$ 11,550	$ 121,550	$ 6,078	$ 127,628	40%	$ 51,051	$ 178,679	5%	$ 8,934
	Sub-Total	**230**	**1610**	**12**	**8**	**0**	**8**	**$ 971,650**	**$ 312,400**	**$ 20,460**	**$ 1,304,510**	**$ 136,974**	**$ 1,441,484**	**$ 72,074**	**$ 1,513,558**		**$ 605,423**	**$ 2,118,981**		**$ 105,949**
6	**Cambridge Street to Gore Street**	65	460	4	0	0	0	$ 266,950	$ 119,260	$ 3,135	$ 389,345	$ 40,881	$ 430,226	$ 21,511	$ 451,738	40%	$ 180,695	$ 632,433	5%	$ 9,035
6	Cambridge Street Crossing	0	0	0	0	0	0	$ -	$ 135,000	$ -	$ 135,000	$ 14,175	$ 149,175	$ 7,459	$ 156,634	40%	$ 62,654	$ 632,433	5%	$ 3,133
	Sub-Total	**65**	**460**	**4**	**0**	**0**	**0**	**$ 266,950**	**$ 254,260**	**$ 3,135**	**$ 524,345**	**$ 55,056**	**$ 579,401**	**$ 28,970**	**$ 608,371**		**$ 243,349**	**$ 1,264,865**		**$ 12,167**
	GRAND TOTAL	**1535 CY**	**11180 SY**	**40 EA**	**54 EA**	**150 LF**	**59 EA**	**$ 4,352,785**	**$ 1,818,480**	**$ 152,705**	**$ 6,323,970**	**$ 664,017**	**$ 6,987,987**	**$ 349,399**	**$ 7,337,386**		**$ 2,934,954**	**$ 10,685,486**		**$ 326,169**

CITY OF CAMBRIDGE - Option 2

Grand Junction Rail with Multi Purpose Trail and One-Way Urban Ring Bus Rapid Transit

Opinion of Probable Construction Costs

Segment No.	Street	Base Construction Total with Contingency **(K+M) = (N)**	Inflation Rate 0.283% per month (fixed)	Construction Total **(I+K+M) = (N)**	Design Fee (Assumed 10% of Total Construction Cost)	Construction Oversight Fee (Assumed 10% of Total Construction Cost)	**Design, Construction, and Construction Oversight TOTAL**
	Units Cost per Unit	$		$	$	$	$
1	**Memorial Drive/Brookline Street Intersection to Massachusetts Avenue**						
1	Memorial Drive/Brookline St Int to Path Extention	$ 252,208	$ 59,955	$ 312,163	$ 31,216	$ 31,216	**$ 374,595**
1	Path Extention to Massachusetts Avenue	$ 4,207,427	$ 1,000,190	$ 5,207,617	$ 520,762	$ 520,762	**$ 6,249,140**
	Sub-Total	**$ 4,459,635**	**$ 1,060,144**	**$ 5,519,779**	**$ 551,978**	**$ 551,978**	**$ 6,623,735**
2	**Massachusetts Avenue to Main Street**	$ 1,682,568	$ 328,555	$ 2,011,123	$ 201,112	$ 201,112	**$ 2,413,348**
2	Massachusetts Avenue Crossing	$ 238,779	$ 46,626	$ 285,406	$ 28,541	$ 28,541	**$ 342,487**
	Sub-Total	**$ 1,921,347**	**$ 375,182**	**$ 2,296,529**	**$ 229,653**	**$ 229,653**	**$ 2,755,835**
3	**Main Street to Broadway**	$ 398,079	$ 70,974	$ 469,053	$ 46,905	$ 46,905	**$ 562,864**
3	Main Street Crossing	$ 26,436	$ 4,713	$ 31,150	$ 3,115	$ 3,115	**$ 37,380**
	Sub-Total	**$ 424,516**	**$ 75,687**	**$ 500,203**	**$ 50,020**	**$ 50,020**	**$ 600,243**
4	**Broadway to Binney Street**	$ 689,697	$ 111,255	$ 800,952	$ 80,095	$ 80,095	**$ 961,143**
4	Broadway Crossing	$ 14,497	$ 2,339	$ 16,836	$ 1,684	$ 1,684	**$ 20,203**
	Sub-Total	**$ 704,195**	**$ 113,594**	**$ 817,788**	**$ 81,779**	**$ 81,779**	**$ 981,346**
5	**Binney Street to Cambridge Street**	$ 2,037,317	$ 276,749	$ 2,314,067	$ 231,407	$ 231,407	**$ 2,776,880**
5	Binney Street Crossing	$ 187,612	$ 25,485	$ 213,098	$ 21,310	$ 21,310	**$ 255,717**
	Sub-Total	**$ 2,224,930**	**$ 302,234**	**$ 2,527,164**	**$ 252,716**	**$ 252,716**	**$ 3,032,597**
6	**Cambridge Street to Gore Street**	$ 641,467	$ 70,799	$ 712,266	$ 71,227	$ 71,227	**$ 854,719**
6	Cambridge Street Crossing	$ 635,565	$ 70,147	$ 705,713	$ 70,571	$ 70,571	**$ 846,855**
	Sub-Total	**$ 1,277,033**	**$ 140,946**	**$ 1,417,979**	**$ 141,798**	**$ 141,798**	**$ 1,701,574**
	GRAND TOTAL	**$ 11,011,655**	**$ 2,067,787**	**$ 13,079,442**	**$ 1,307,944**	**$ 1,307,944**	**$ 15,695,330**

CITY OF CAMBRIDGE - Option 2 - Grand Junction Rail with Multi Purpose Trail and One-Way Urban Ring Bus Rapid Transit

Opinion of Probable Construction Costs

Track and Railroad Signal Breakdown

Track Relocation Estimate Completed by Edwards & Kelcey

Work ID No.	Item Descriptions	Unit	Quantity	Unit Cost	TOTAL
Segment 1A - Begins at the siding turnout just east of Memorial Drive and continues to the southwest corner of the triangular lot just east of the pedestrian crossing					
1	Remove and Relocate Track - Mainline	LF	1,900	$110	$209,000
1	Remove and Relocate Track - Siding	LF	1,900	$110	$209,000
2	Relocate Existing Pedestrian Grade Crossing Signal Equipment (Gates)	LS	1	$50,000	$50,000
3	Remove Necco Sidetrack	LF	1,500	$40	$60,000
3	Remove Turnout for Necco Sidetrack	LS	1	$25,000	$25,000
4	Remove and Relocate Pedestrian Grade Crossing	LF	10	$300	$3,000
5	Construction Staging at Siding Turnouts	LF	300	$150	$45,000
6	Railroad Testing/Acceptance	LS	1	$3,200	$3,200
7	Flagging Protection	LS	1	$48,000	$48,000
					$652,200
Segment 1B - Begins from the pedestrian crossing and continues to the west edge of the Massachusetts Avenuegrade crossing					
1	Remove and Relocate Track - Mainline	LF	2,750	$110	$302,500
1	Remove and Relocate Track - Siding	LF	2,750	$110	$302,500
5	Construction Staging at Siding Turnouts	LF	300	$150	$45,000
6	Railroad Testing/Acceptance	LS	1	$1,600	$1,600
7	Flagging Protection	LS	1	$67,200	$67,200
					$718,800
Segment 2 - Begins from the Massachusetts Avenue grade crossing and continues to the west edge of the Main Street grade crossing					
3	Remove Mainline Track	LF	1500	$40	$60,000
1a	Build New Mainline Track	LF	1500	$200	$300,000
2	Relocate Existing Pedestrian Grade Crossing Signal Equipment (Gates)	LS	1	$50,000	$50,000
2	Relocate Existing Mass Ave. Grade Crossing Signal Equipment (Flashers)	LS	1	$175,000	$175,000
4	Remove and Relocate Mass. Ave. Grade Crossing	LF	100	$300	$30,000
4	Remove and Relocate Pedestrian Grade Crossing	LF	10	$300	$3,000
6	Railroad Testing/Acceptance	LS	1	$6,400	$6,400
7	Flagging Protection	LS	1	$19,200	$19,200
					$643,600

Total = $2,014,600

Average Price per LF (assuming 5,200 LF of track is relocated) = $387

SAY $400 per LF

Work ID No. - Task Description and Assumptions

1 Cost includes equipment and labor necessary to remove and relocate existing track, clearing and grubbing, build new trackbed for relocated track, and disposal of hazardous and non-hazardous materials.

1a Cost includes the equipment and labor necessary to install subballast, ballast, ties, and rails to complete a new track.

2 Cost includes the equipment and labor necessary to relocate existing at-grade crossing signal equipment (i.e., cable, conduit, mast arms, controller box, crossing surface material, etc)

3 Cost includes the equipment and labor necessary to remove and salvage existing rails, ties, switching mechanisms, and ballast and transport salvaged materials to owner. Material that is not salvaged will be removed and disposed.

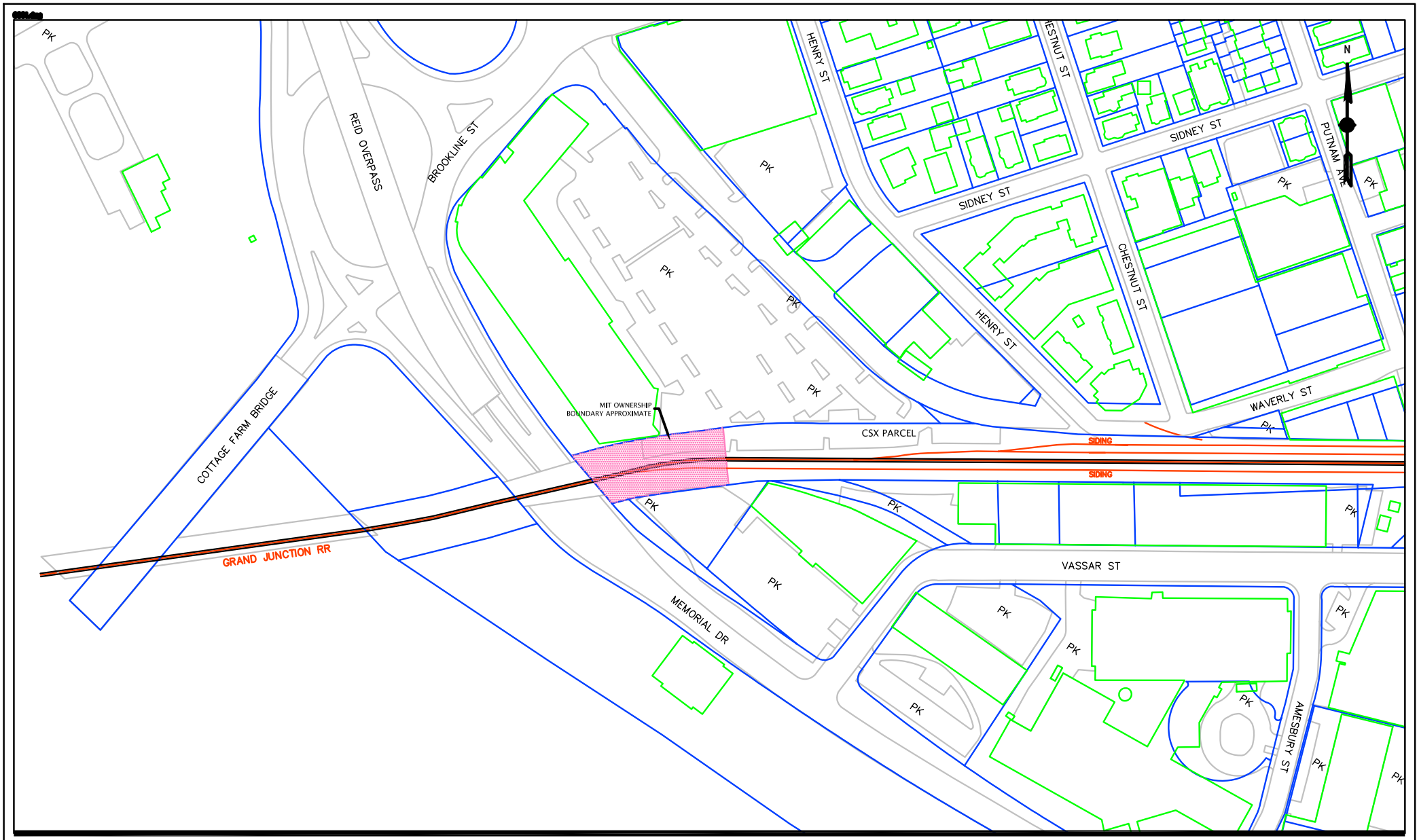
4 Cost includes the equipment and labor necessary to remove and relocate existing grade crossing, build new trackbed for relocated crossing, purchase and install new crossing surface, and disposal of hazardous and non-hazardous materials.

5 Cost includes the equipment and labor necessary for staged construction at existing turnouts to allow existing train movements to continue.

6 Cost includes the loaded rate for track and signal inspection and acceptance by the railroad.

7 Cost includes the loaded rate for flagging protection during track construction operations.

APPENDIX B: PROPERTY OWNERSHIP



Parcel Owners
- MIT
- CSX Easement

alta PLANNING + DESIGN

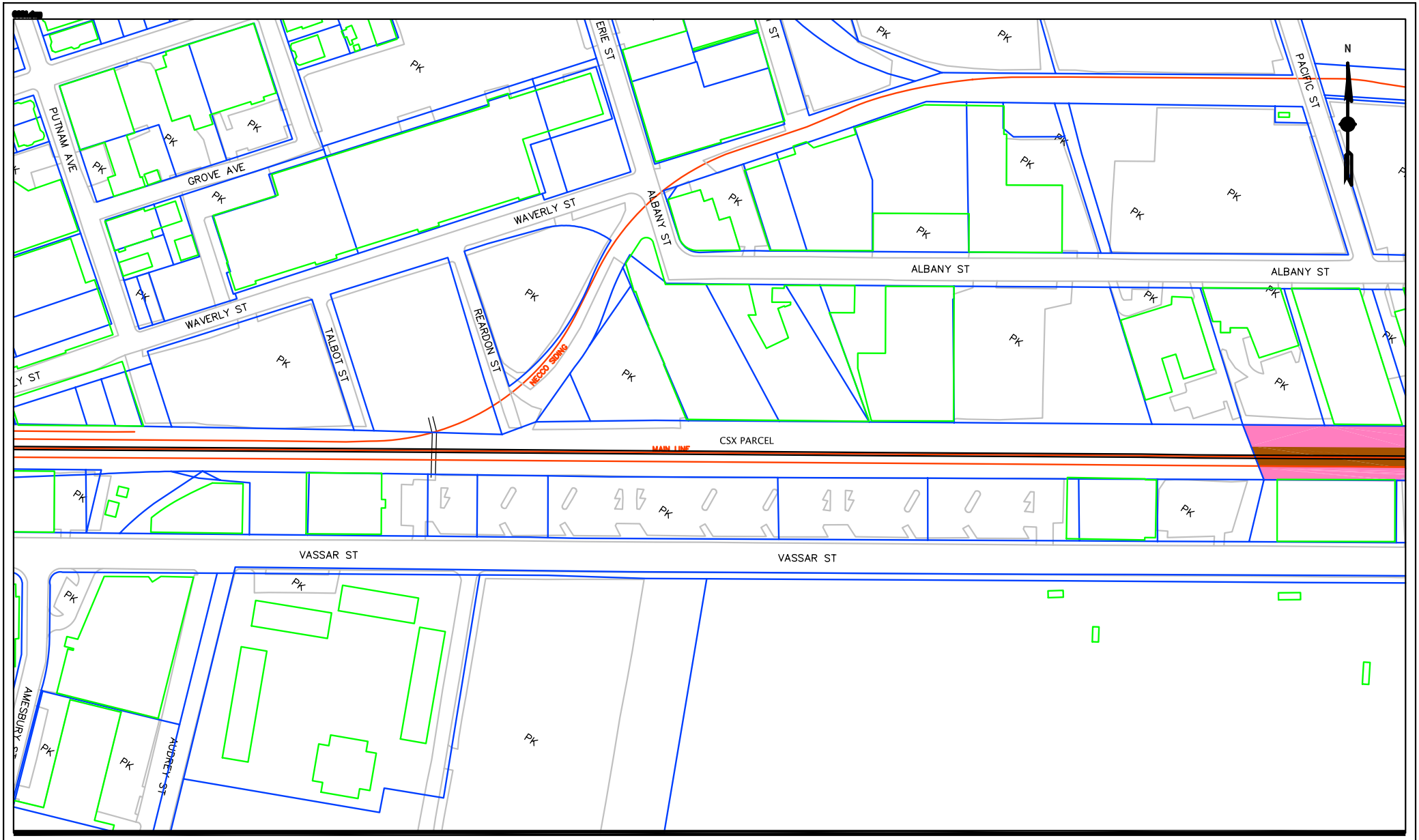
SHEET 1 of 7

Source: City of Cambridge Community Development Department

Grand Junction Rail with Trail

Land Ownership and Easements

Cambridge, MA



Parcel Owners
- MIT
- CSX Easement

alta PLANNING + DESIGN

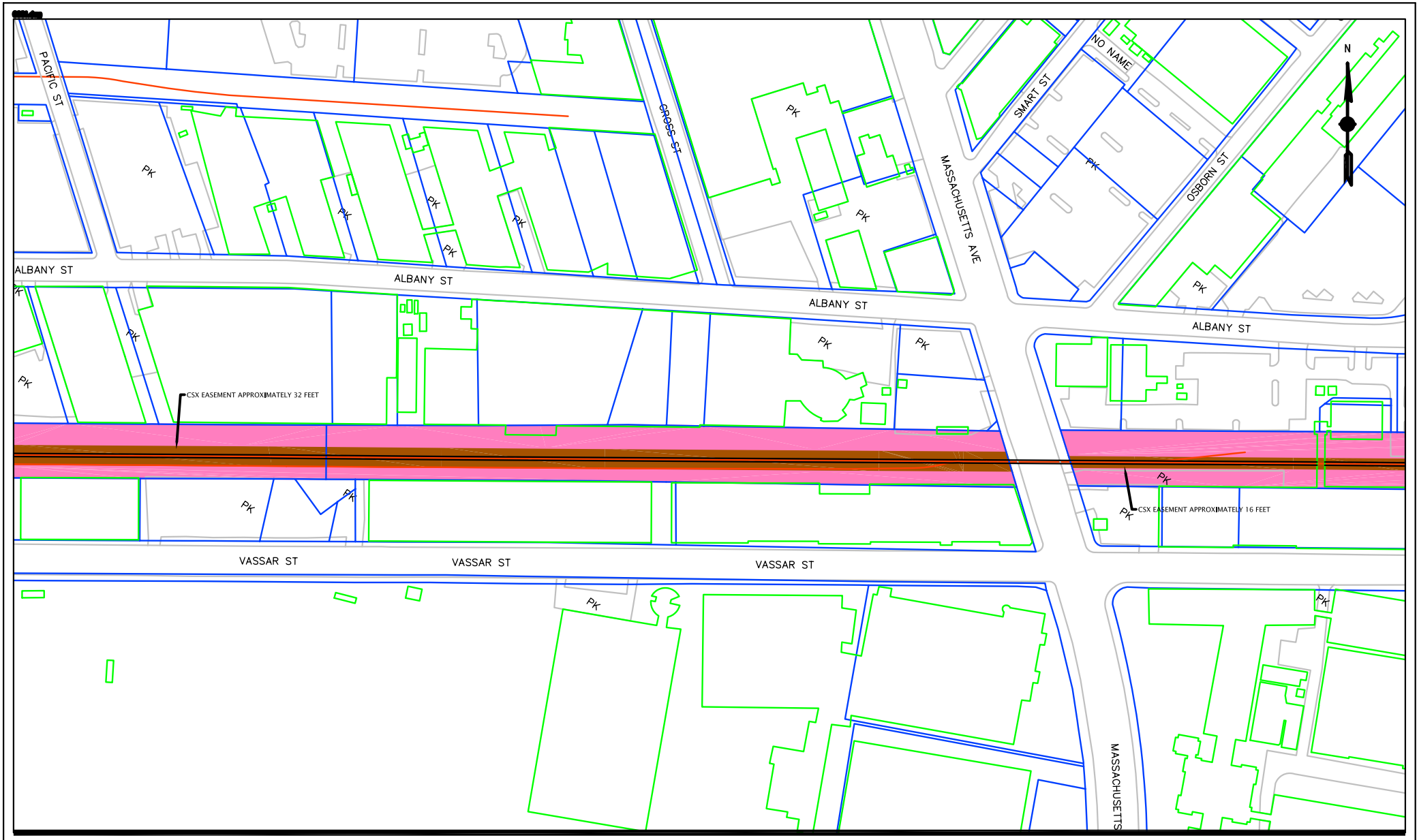
SHEET 2 of 7

Source: City of Cambridge Community Development Department

Grand Junction Rail with Trail

Land Ownership and Easements

Cambridge, MA



Parcel Owners

- MIT
- CSX Easement

alta PLANNING + DESIGN

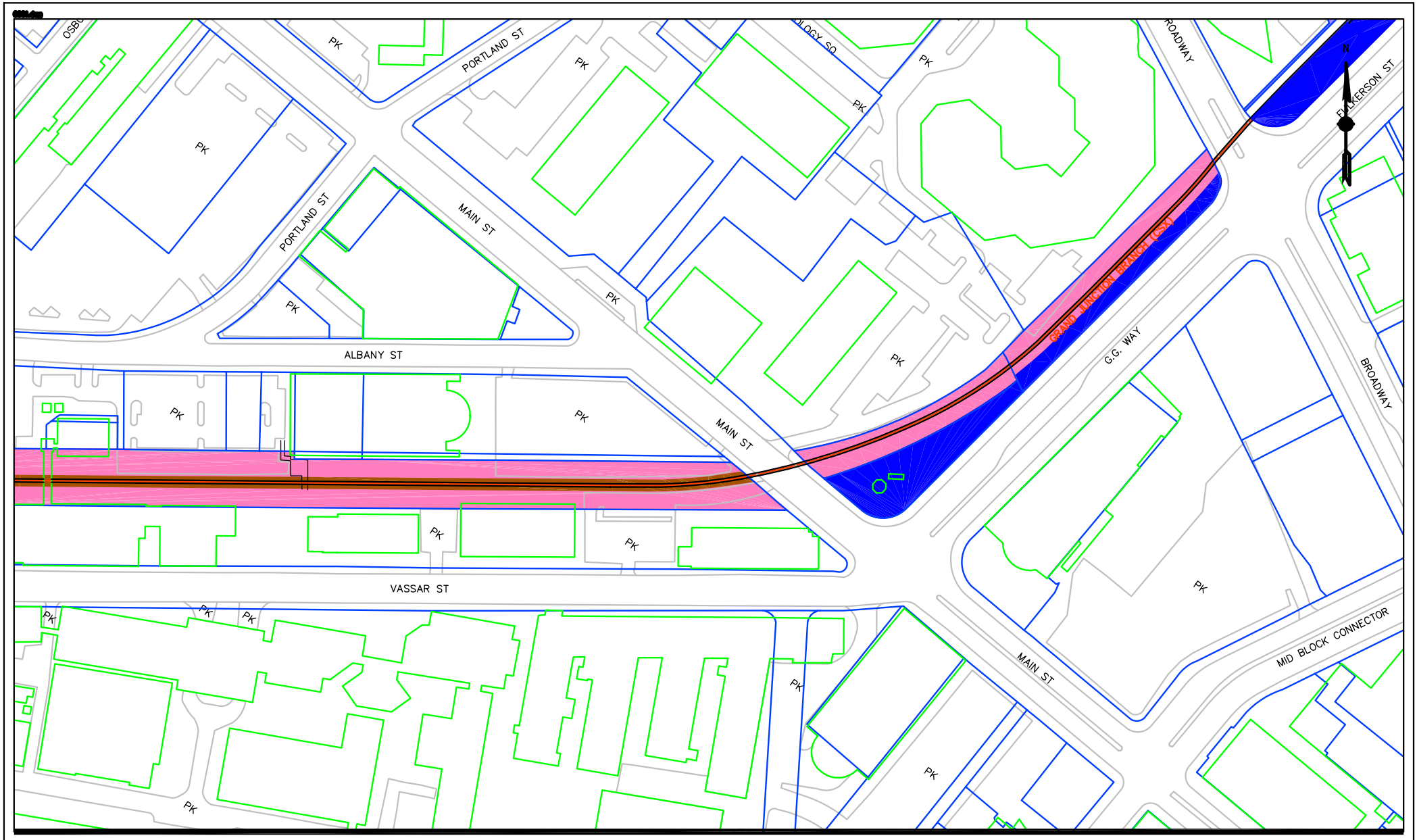
SHEET 3 of 7

Source: City of Cambridge Community Development Department

Grand Junction Rail with Trail

Land Ownership and Easements

Cambridge, MA



alta PLANNING + DESIGN

SHEET 4 of 7

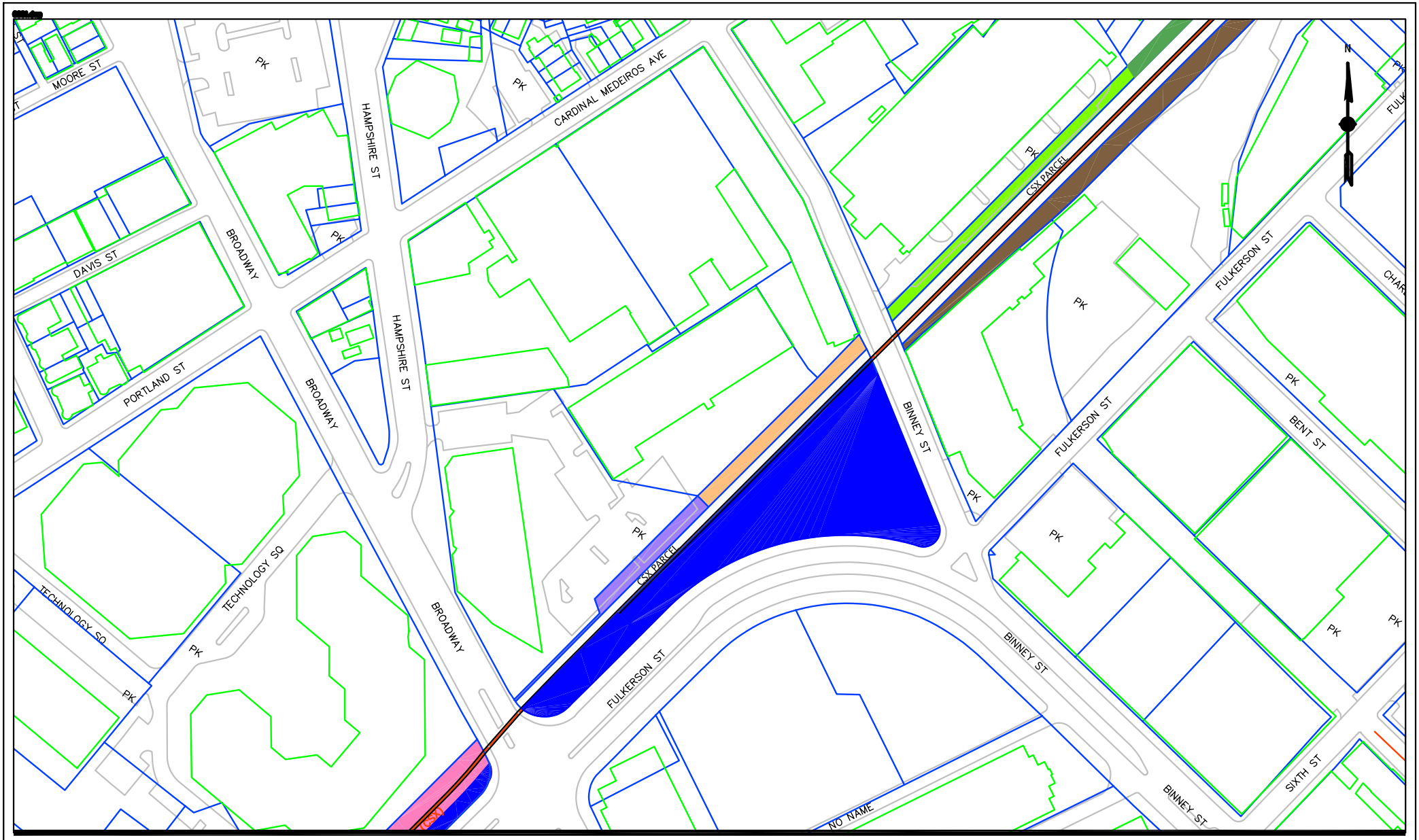
Source: City of Cambridge Community Development Department

Parcel Owners
- MIT
- CSX Easement
- CRA

Grand Junction Rail with Trail

Land Ownership and Easements

Cambridge, MA



Parcel Owners

- MIT
- CRA
- DRAPER
- AMGEN
- SPAULDING & SLYE
- UNKNOWN

alta PLANNING + DESIGN

SHEET 5 of 7

Source: City of Cambridge Community Development Department

Grand Junction Rail with Trail

Land Ownership and Easements

Cambridge, MA

Parcel Owners

- CITY OF CAMBRIDGE
- LINDEN PARK HOMES INC
- ARCHDIOCESE OF BOSTON
- HAIR AND NAIL SALON
- CRA
- SPAULDING & SLYE
- UNKNOWN

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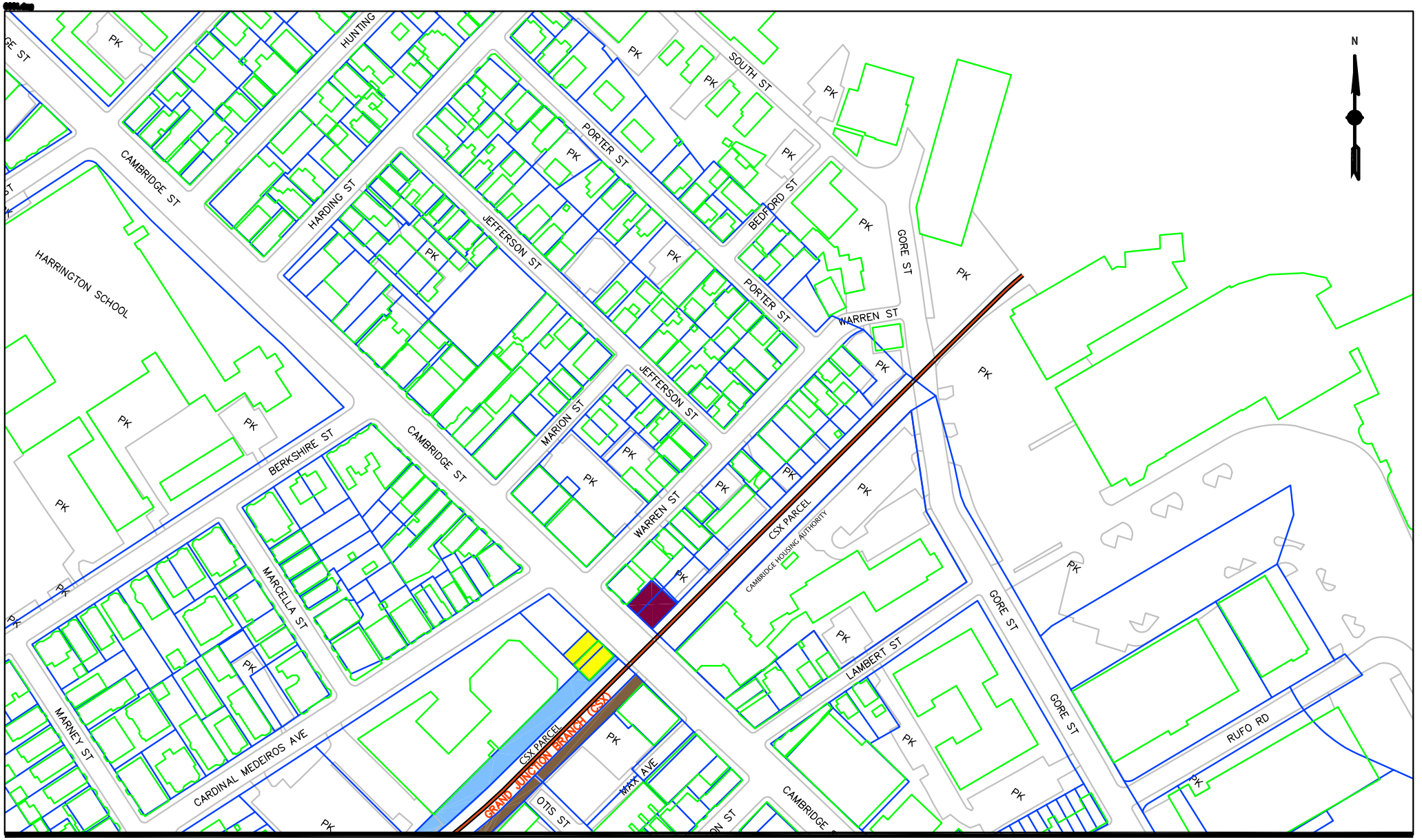
SHEET 6 of 7

Source: City of Cambridge Community Development Department

Grand Junction Rail with Trail

Land Ownership and Easements

Cambridge, MA



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SHEET 7 of 7

Source: City of Cambridge Community Development Department

Parcel Owners

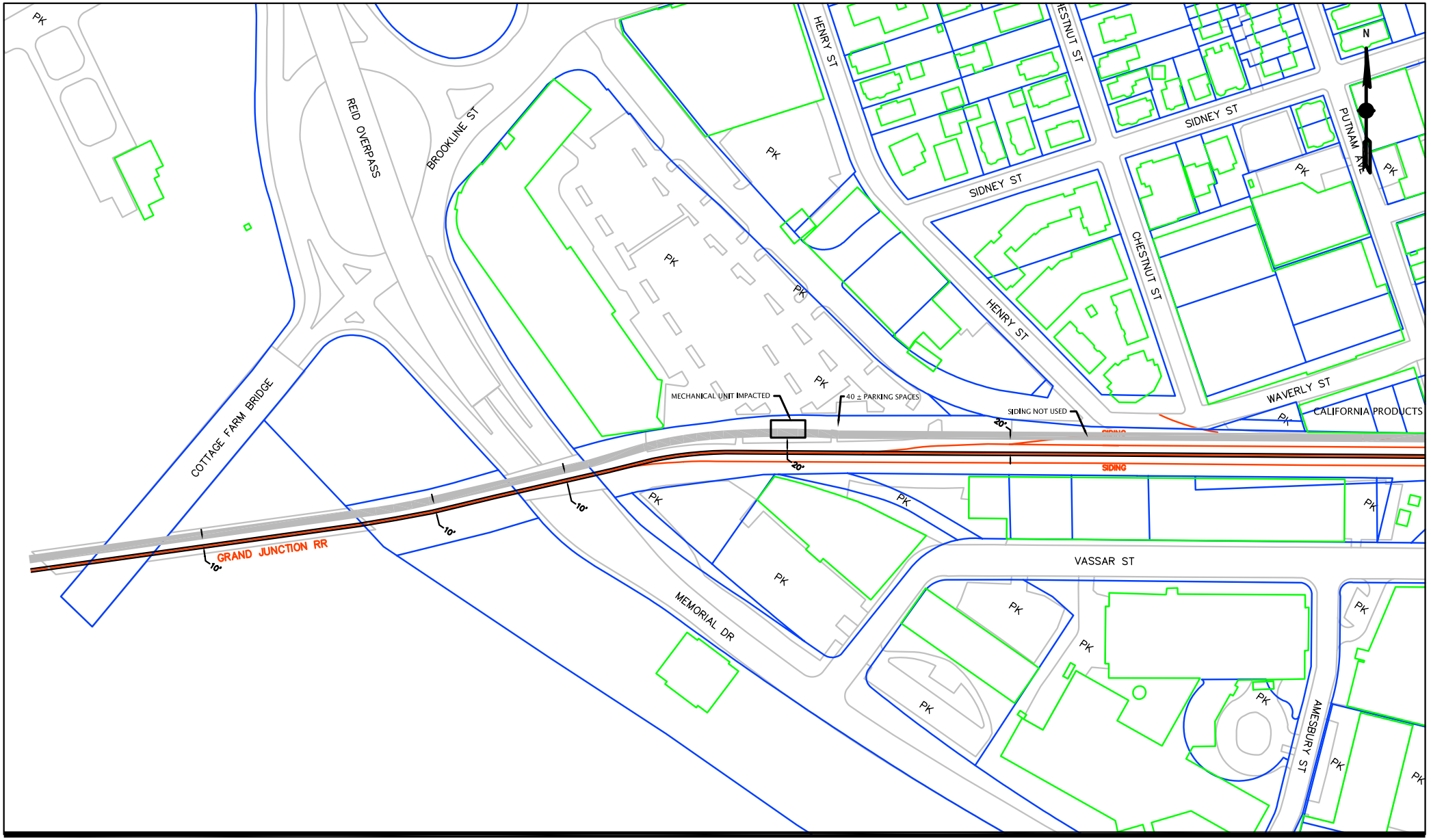
- ARCHDIOCESE OF BOSTON
- HAIR AND NAIL SALON
- CITY OF CAMBRIDGE
- UNKNOWN

Grand Junction Rail with Trail

Land Ownership and Easements

Cambridge, MA

Appendix C: Detailed Trail Layout



alta PLANNING + DESIGN

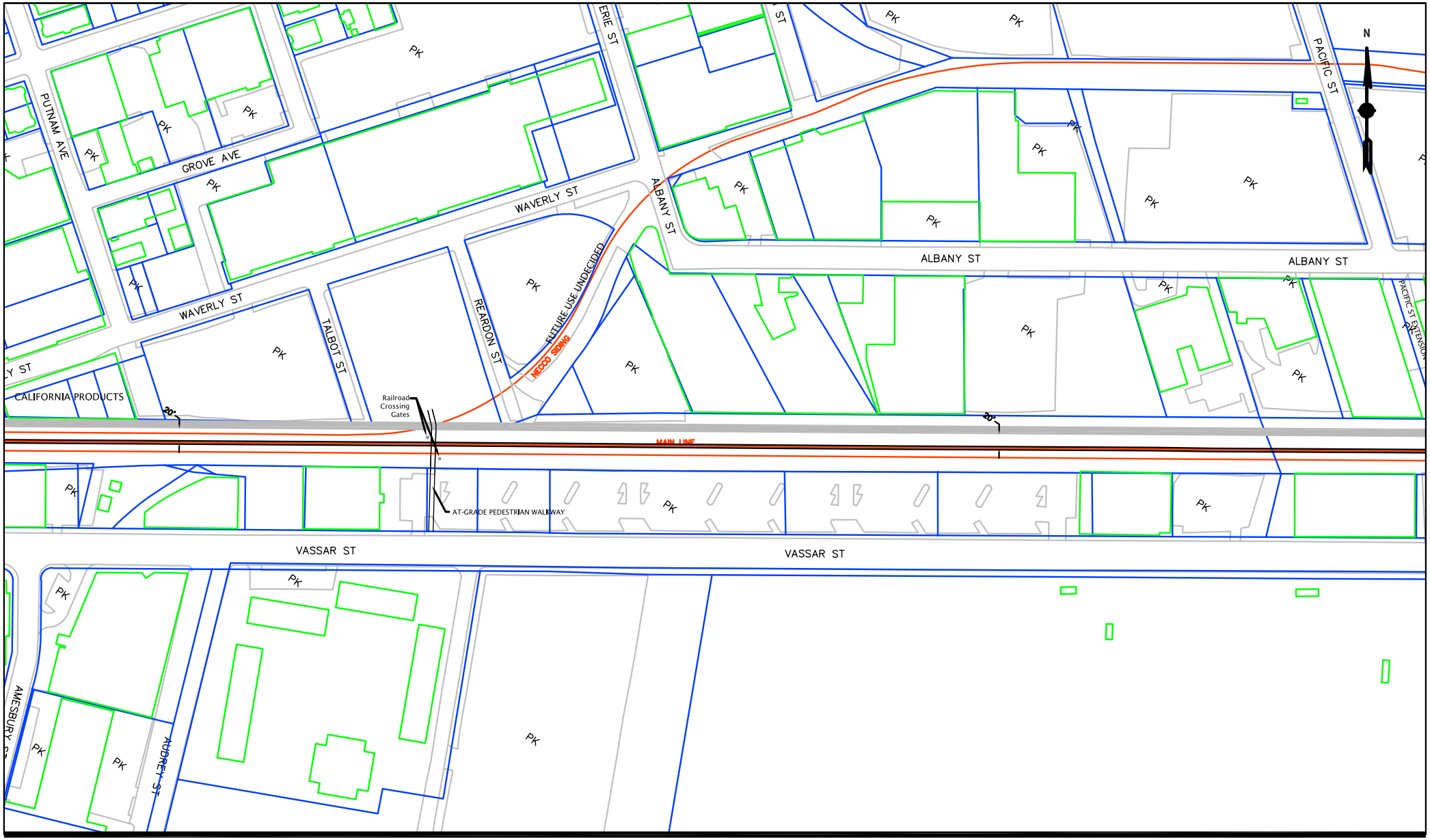
SHEET 1 OF 7

Source: City of Cambridge Community Development Department
*No Urban Ring on Surface in Corridor

Grand Junction Rail with Trail

Alternative 1: Concept Plan*

Cambridge, MA



alta PLANNING + DESIGN

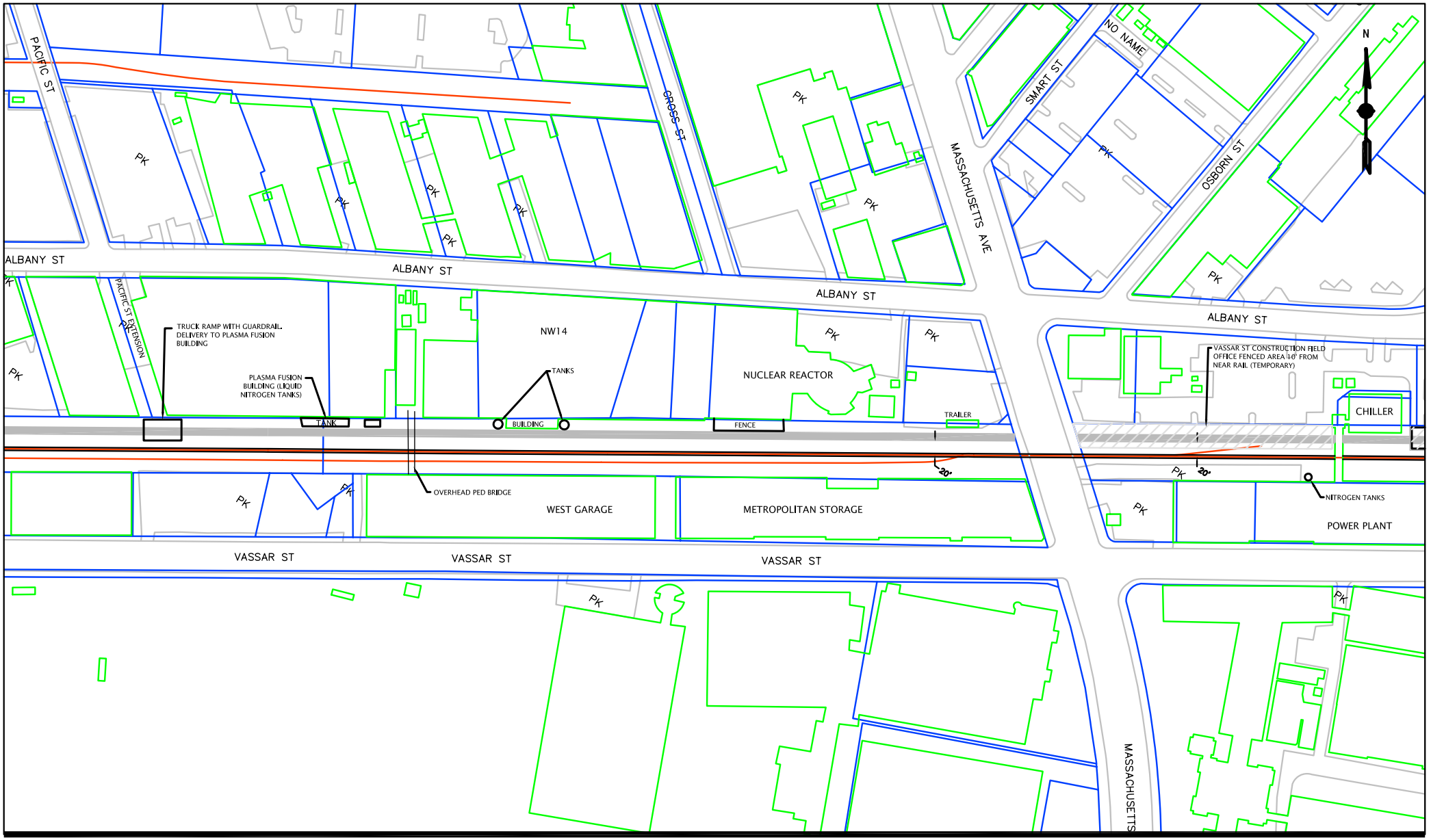
SHEET 2 of 7

Source: City of Cambridge Community Development Department
*No Urban Ring on Surface in Corridor

Grand Junction Rail with Trail

Alternative 1: Concept Plan*

Cambridge, MA



Grand Junction Rail with Trail

Alternative 1: Concept Plan*

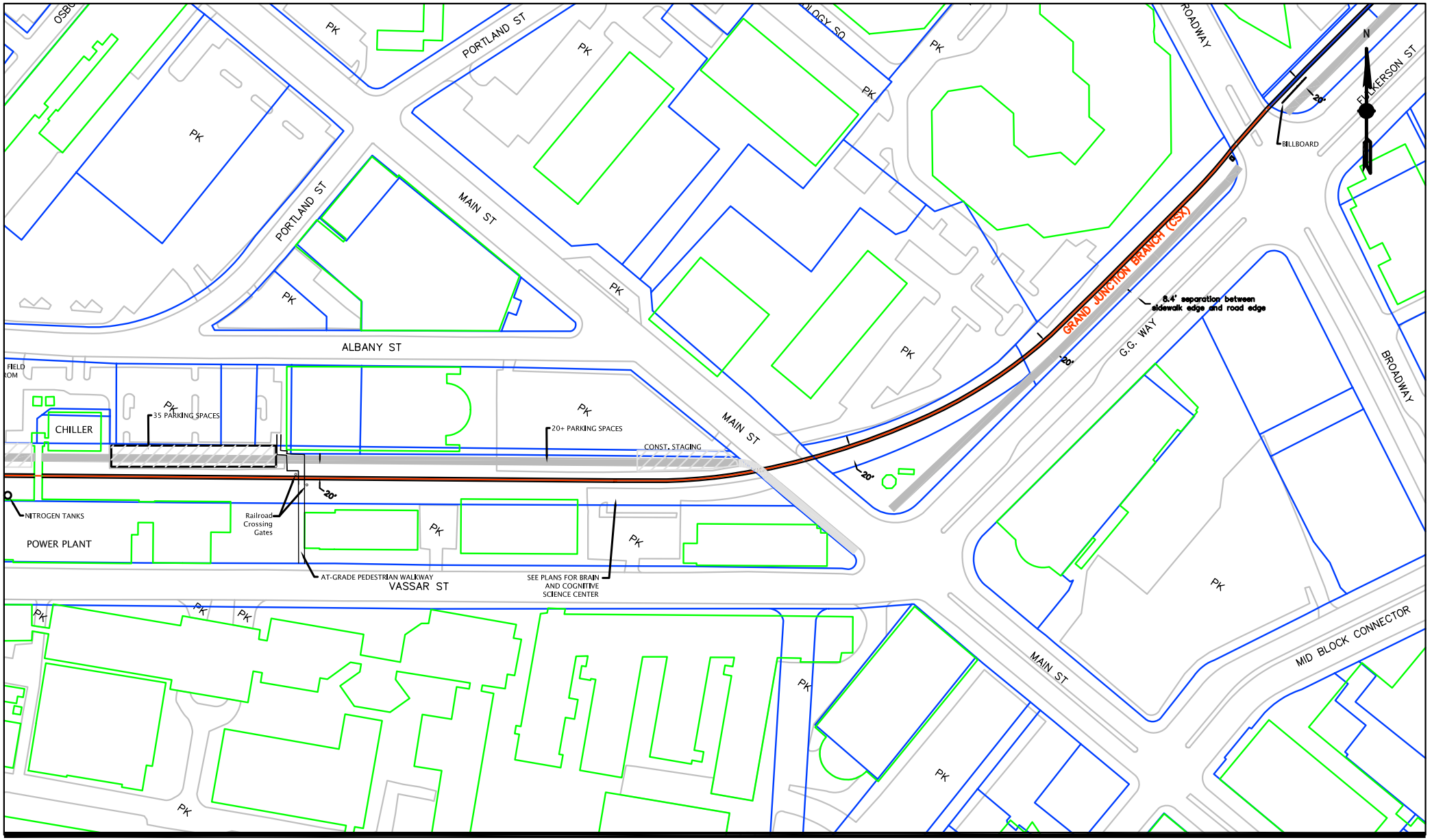
Cambridge, MA

alta PLANNING + DESIGN

SHEET 3 of 7

Source: City of Cambridge Community Development Department

*No Urban RIng on Surface In Corridor



Grand Junction Rail with Trail

Alternative 1: Concept Plan*

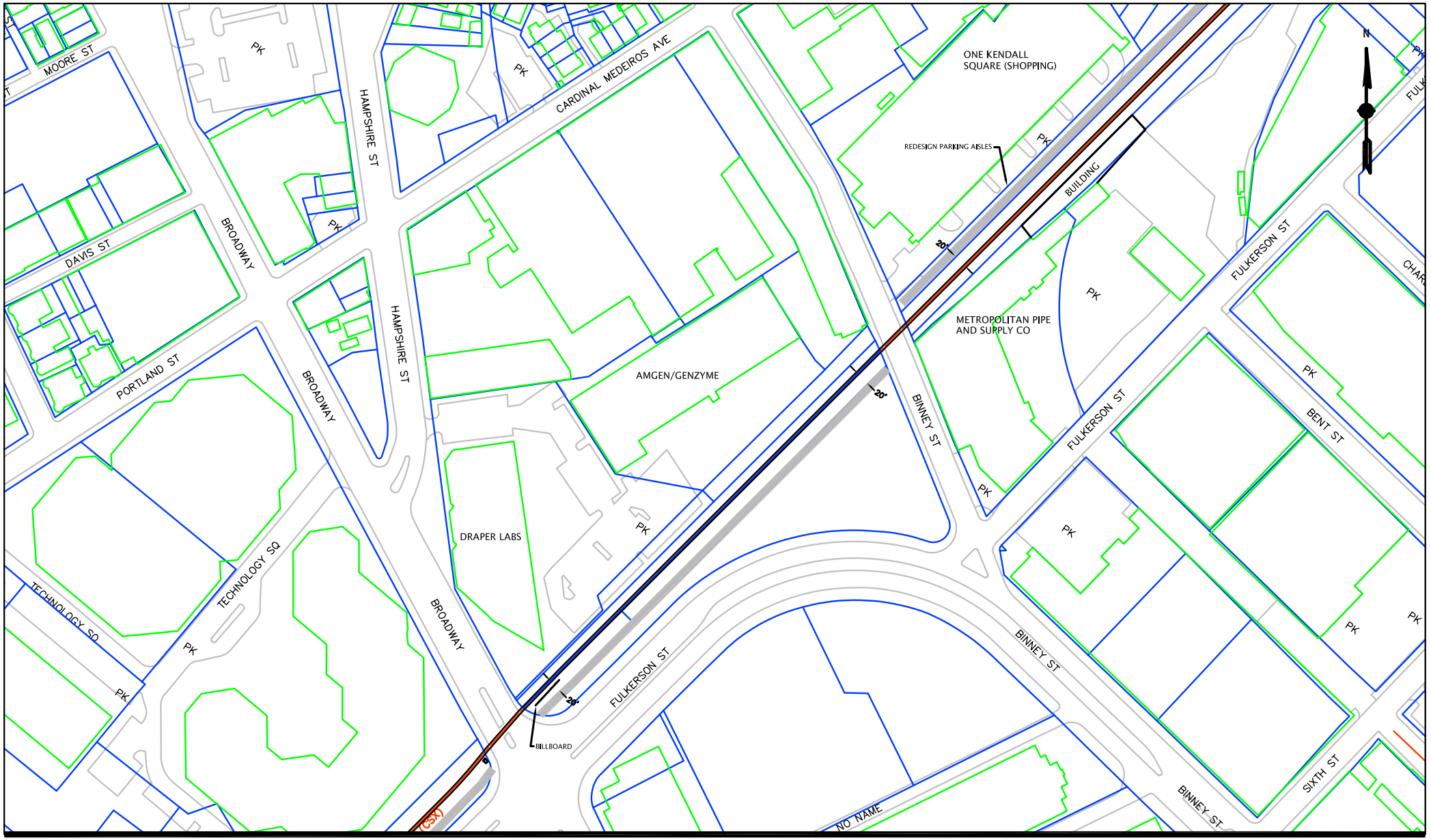
Cambridge, MA

alta PLANNING + DESIGN

SHEET 4 of 7

Source: City of Cambridge Community Development Department

*No Urban Ring on Surface in Corridor



alta PLANNING + DESIGN

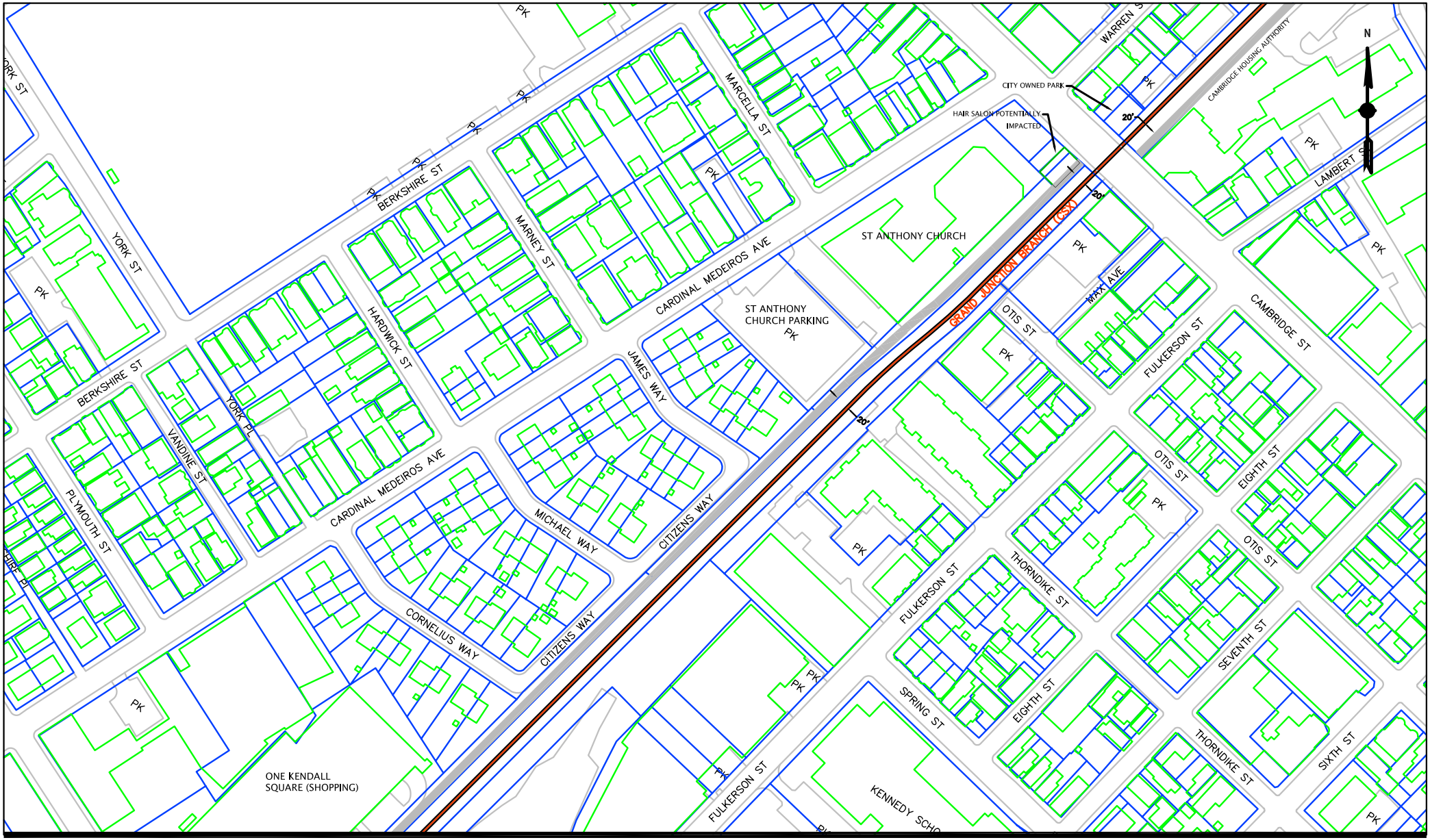
SHEET 5 of 7

Source: City of Cambridge Community Development Department
*No Urban Ring on Surface in Corridor

Grand Junction Rail with Trail

Alternative 1: Concept Plan*

Cambridge, MA



alta PLANNING + DESIGN

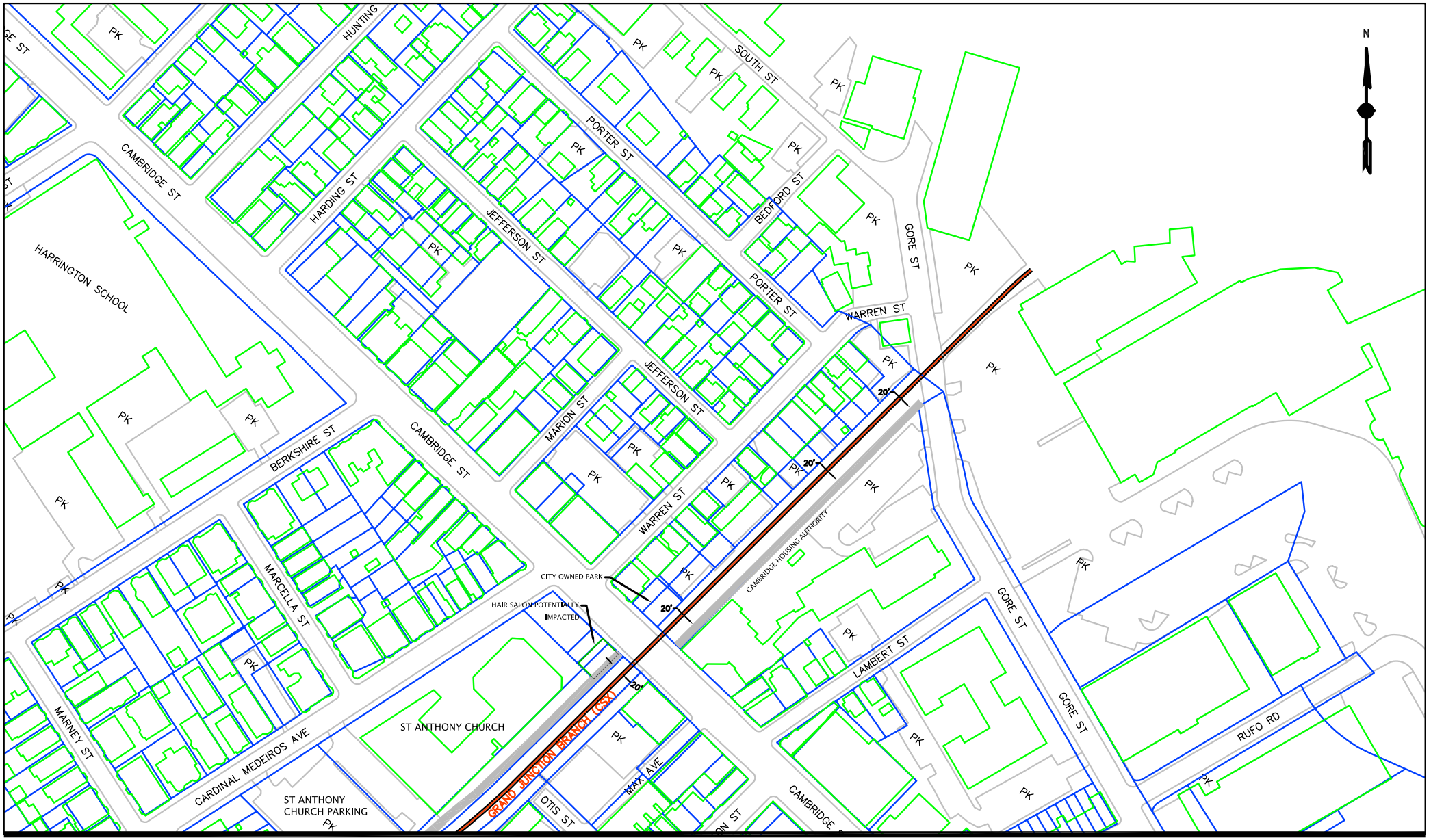
SHEET 6 of 7

Source: City of Cambridge Community Development Department
*No Urban Ring on Surface in Corridor

Grand Junction Rail with Trail

Alternative 1: Concept Plan*

Cambridge, MA



Grand Junction Rail with Trail

Alternative 1: Concept Plan*

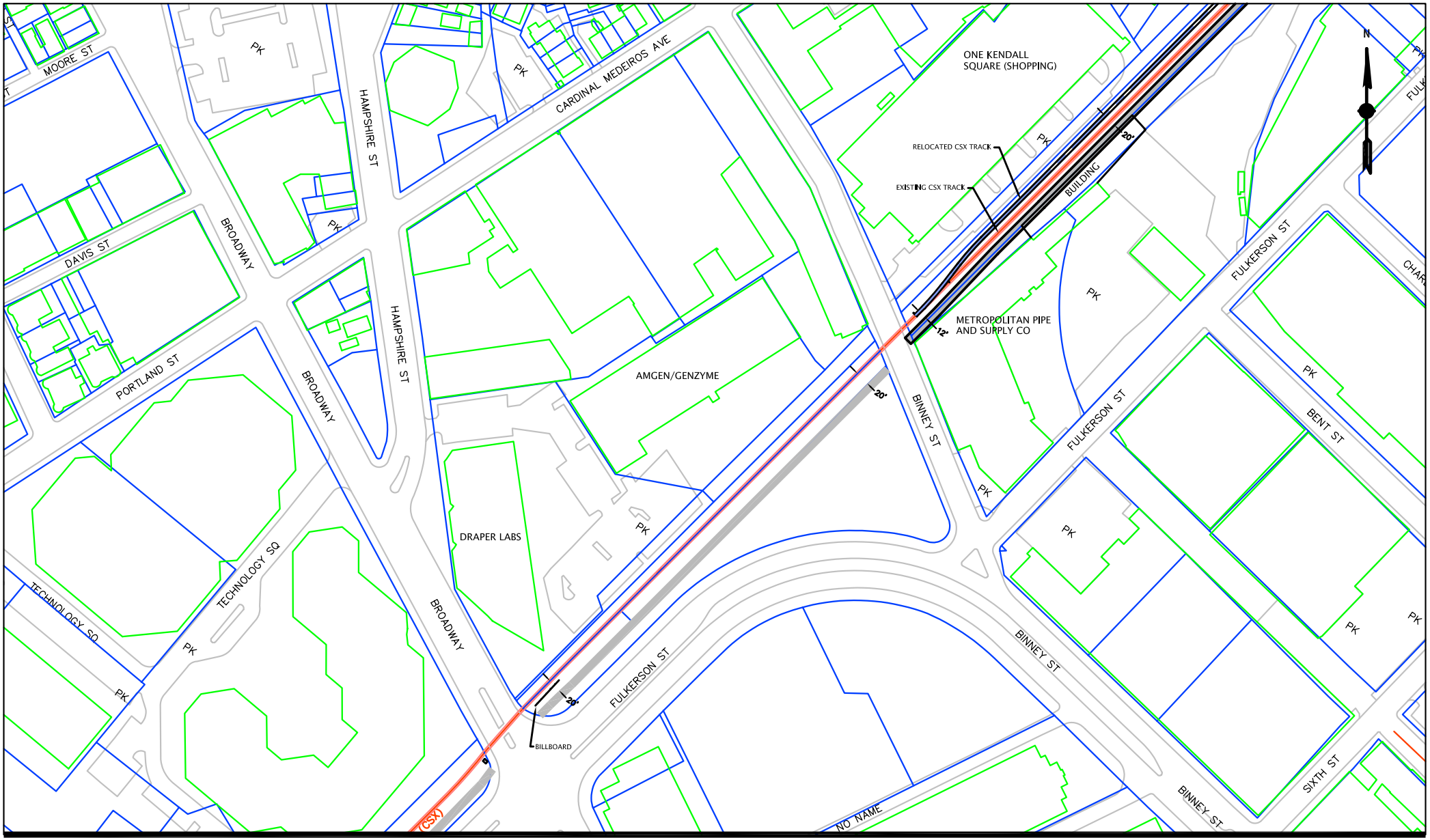
Cambridge, MA

alta PLANNING + DESIGN

SHEET 7 of 7

Source: City of Cambridge Community Development Department

*No Urban RIng on Surface In Corridor



Grand Junction Rail with Trail - 20 foot offset

Alternative 1B: Concept Plan*

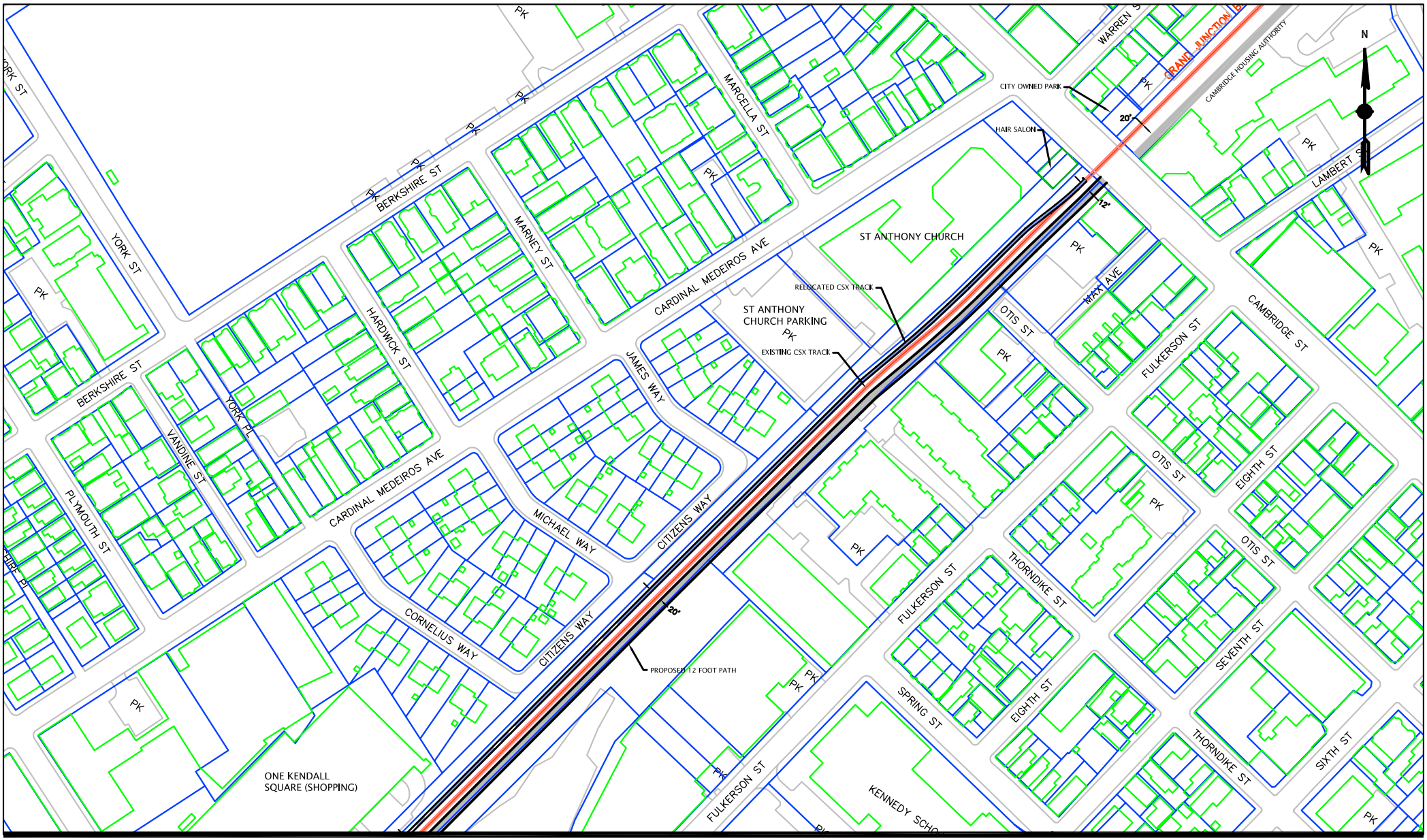
Cambridge, MA

alta PLANNING + DESIGN

SHEET 5 of 7

Source: City of Cambridge Community Development Department

*No Urban RIng on Surface In Corridor



Grand Junction Rail with Trail - 20 foot offset

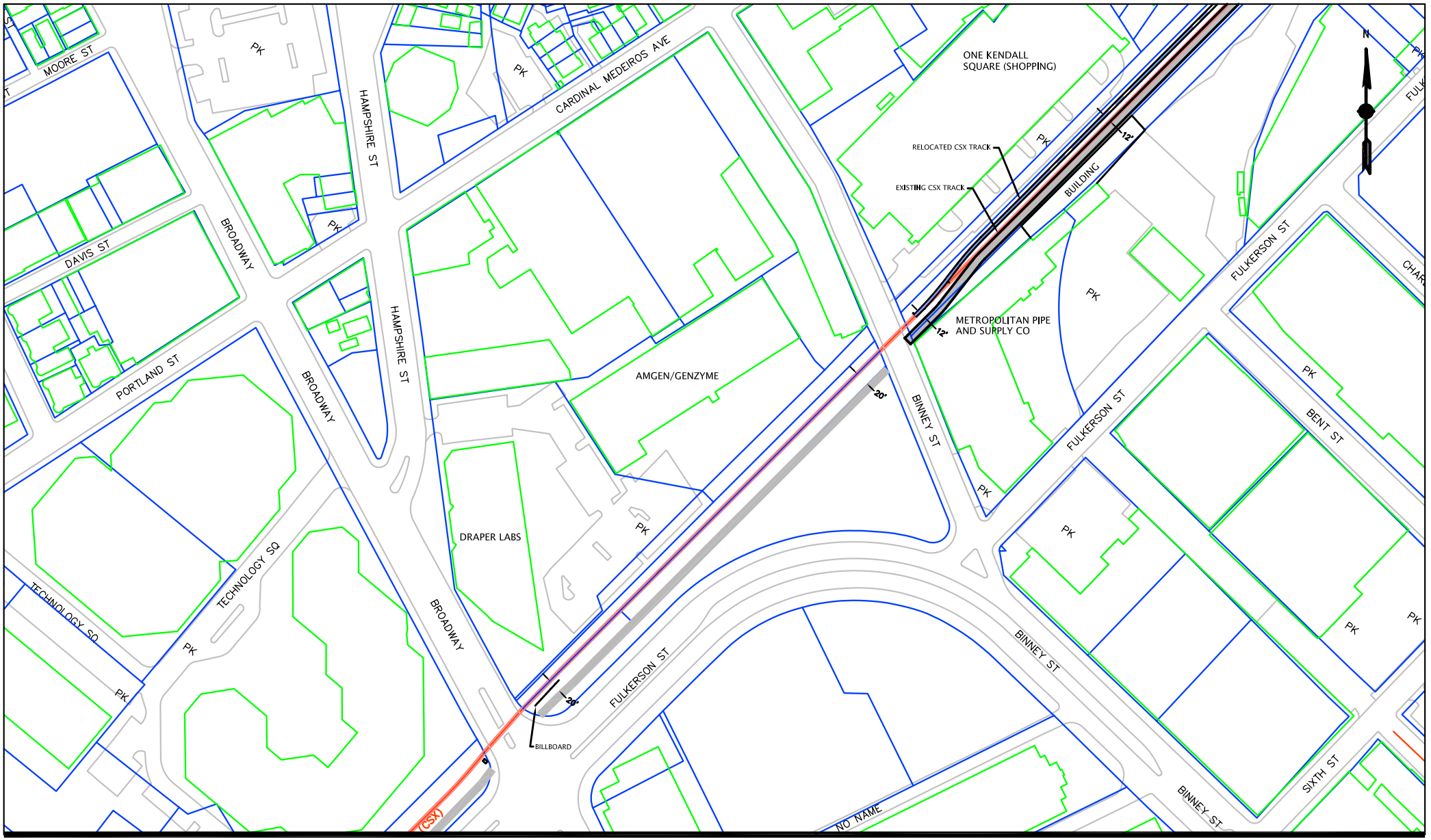
Alternative 1B: Concept Plan*

Cambridge, MA

alta PLANNING + DESIGN

SHEET 6 of 7
1"=60'

Source: City of Cambridge Community Development Department
*No Urban Ring on Surface in Corridor



Grand Junction Rail with Trail - 12 foot offset

Alternative 1C: Concept Plan*

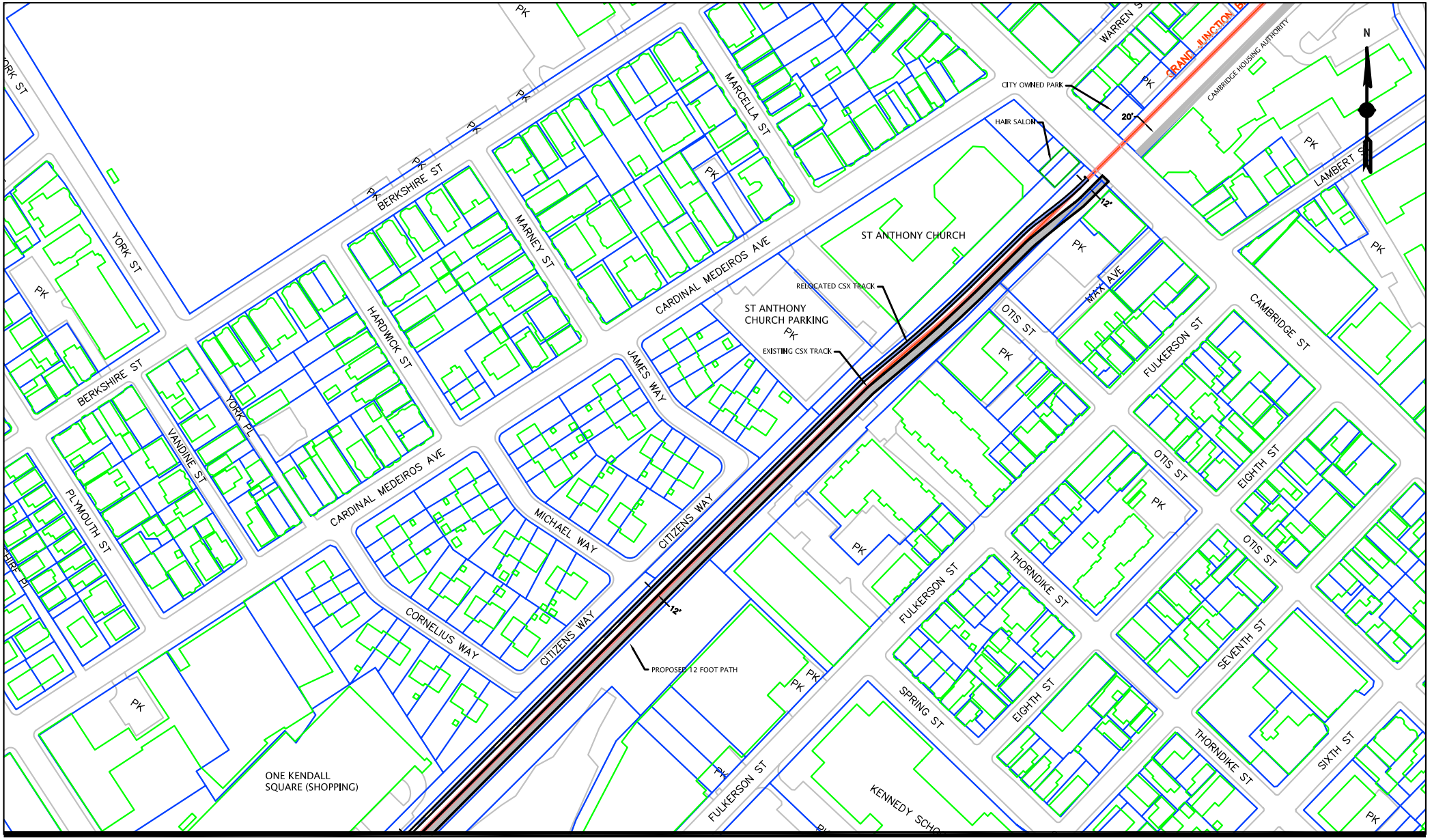
Cambridge, MA

alta PLANNING + DESIGN

SHEET 5 of 7

Source: City of Cambridge Community Development Department

*No Urban Ring on Surface in Corridor



alta PLANNING + DESIGN

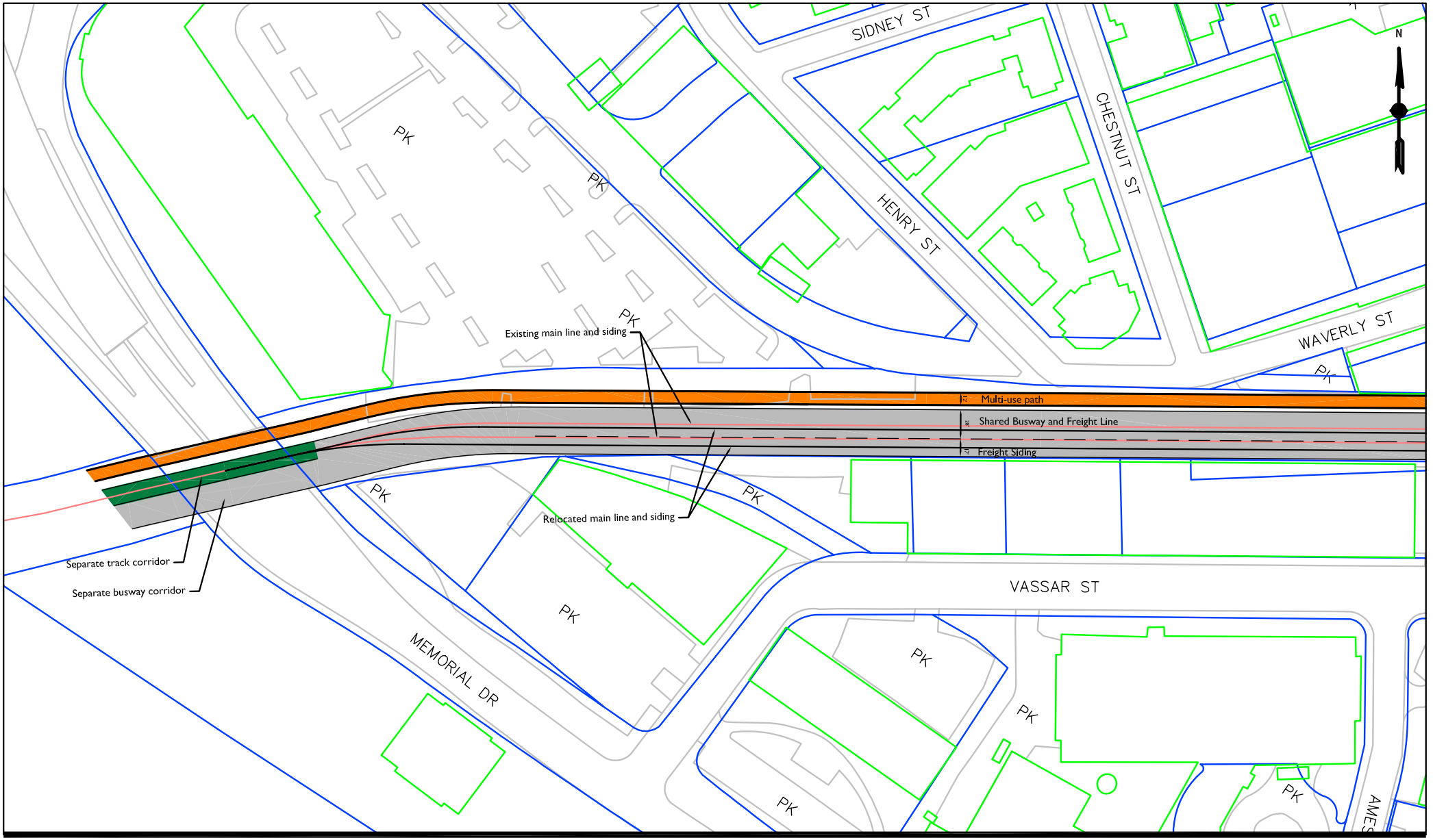
SHEET 6 of 7

Source: City of Cambridge Community Development Department
*No Urban Ring on Surface in Corridor

Grand Junction Rail with Trail - 12 foot offset

Alternative 1C: Concept Plan*

Cambridge, MA



alta PLANNING + DESIGN

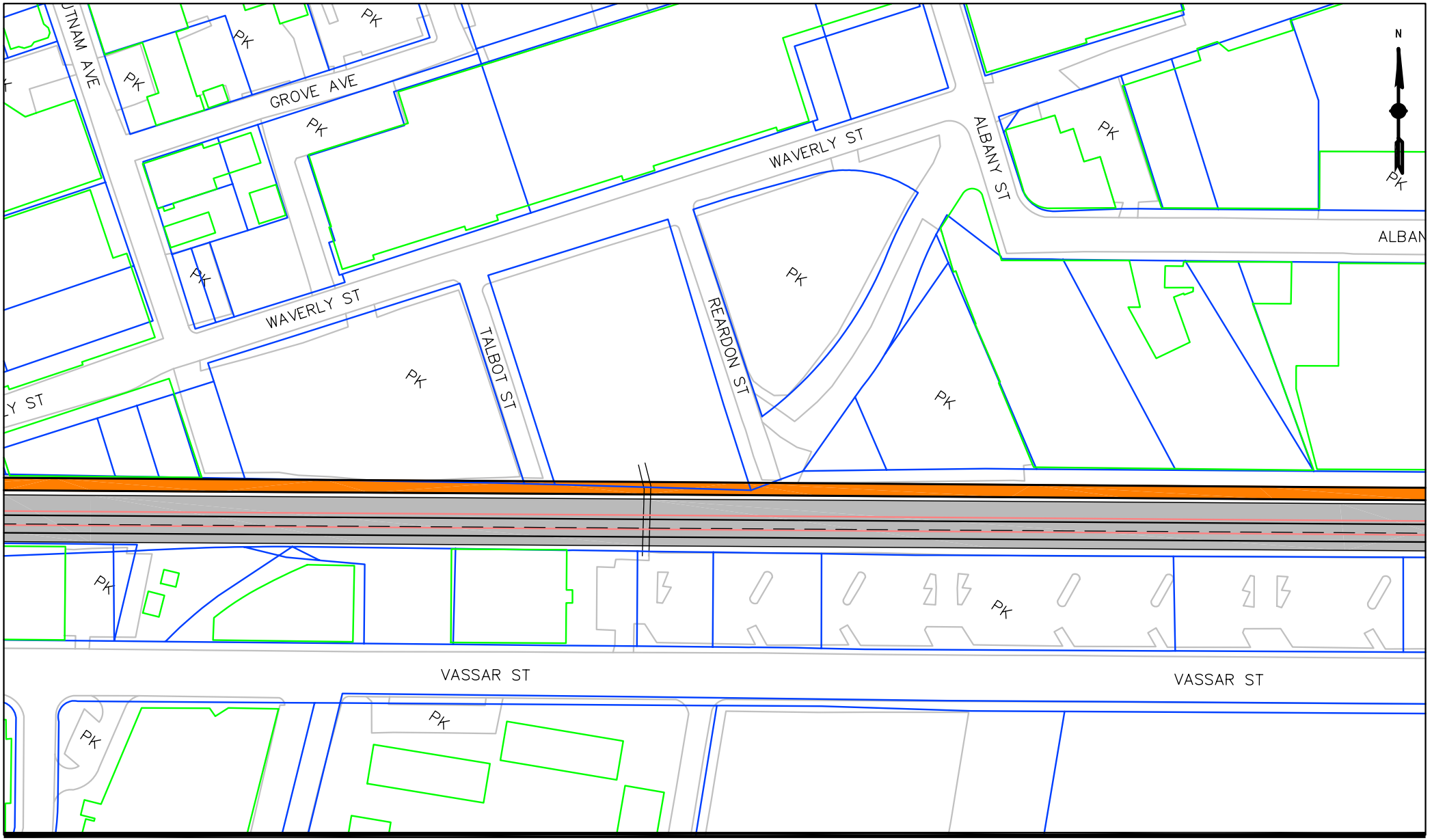
SHEET 1 of 5

Base: City of Cambridge

Grand Junction Rail with Trail

Alternative 2: Urban Ring-Bus Rapid Transit

Cambridge, MA



alta PLANNING + DESIGN

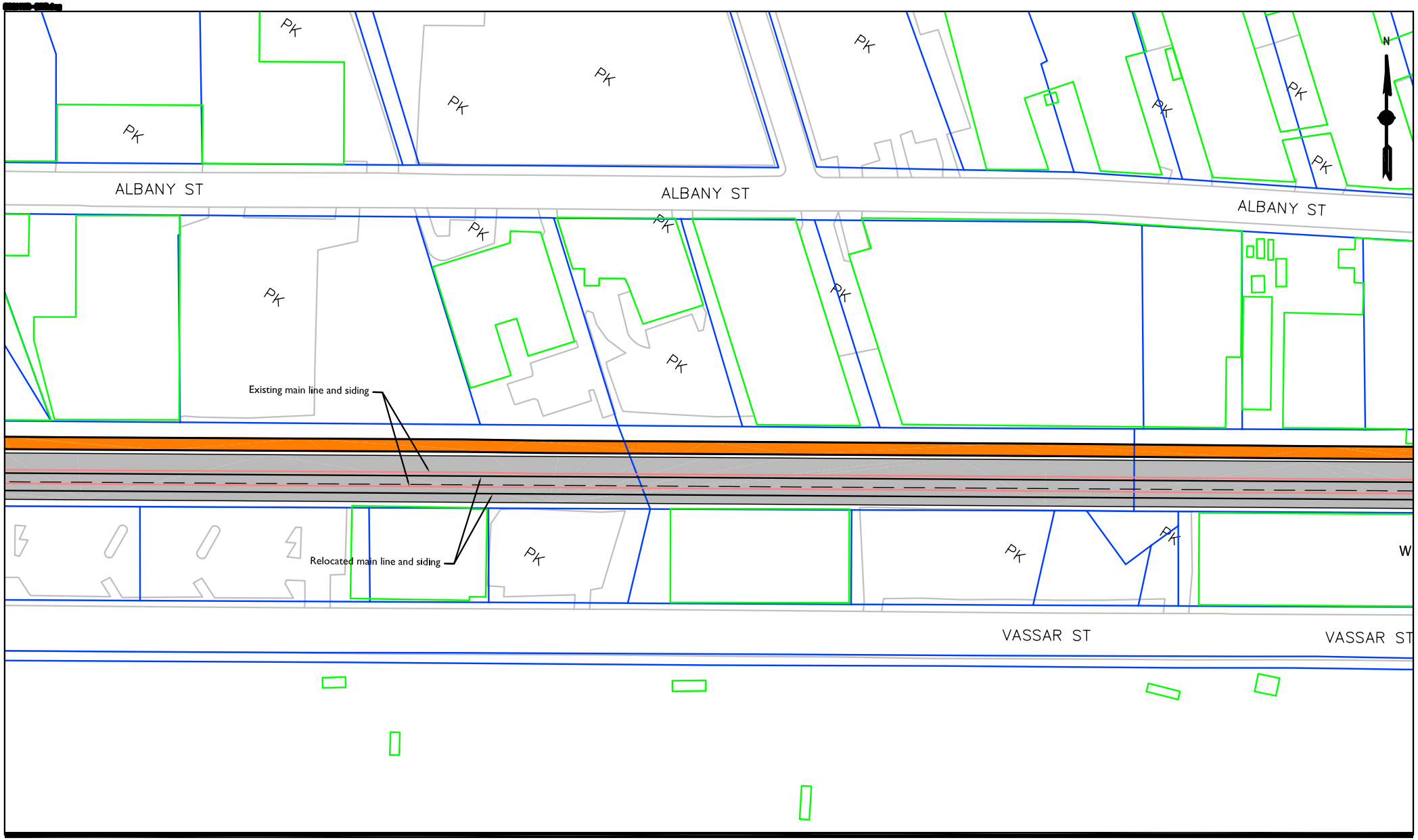
SHEET 2 of 5

Base: City of Cambridge

Grand Junction Rail with Trail

Alternative 2: Urban Ring-Bus Rapid Transit

Cambridge, MA



alta PLANNING + DESIGN

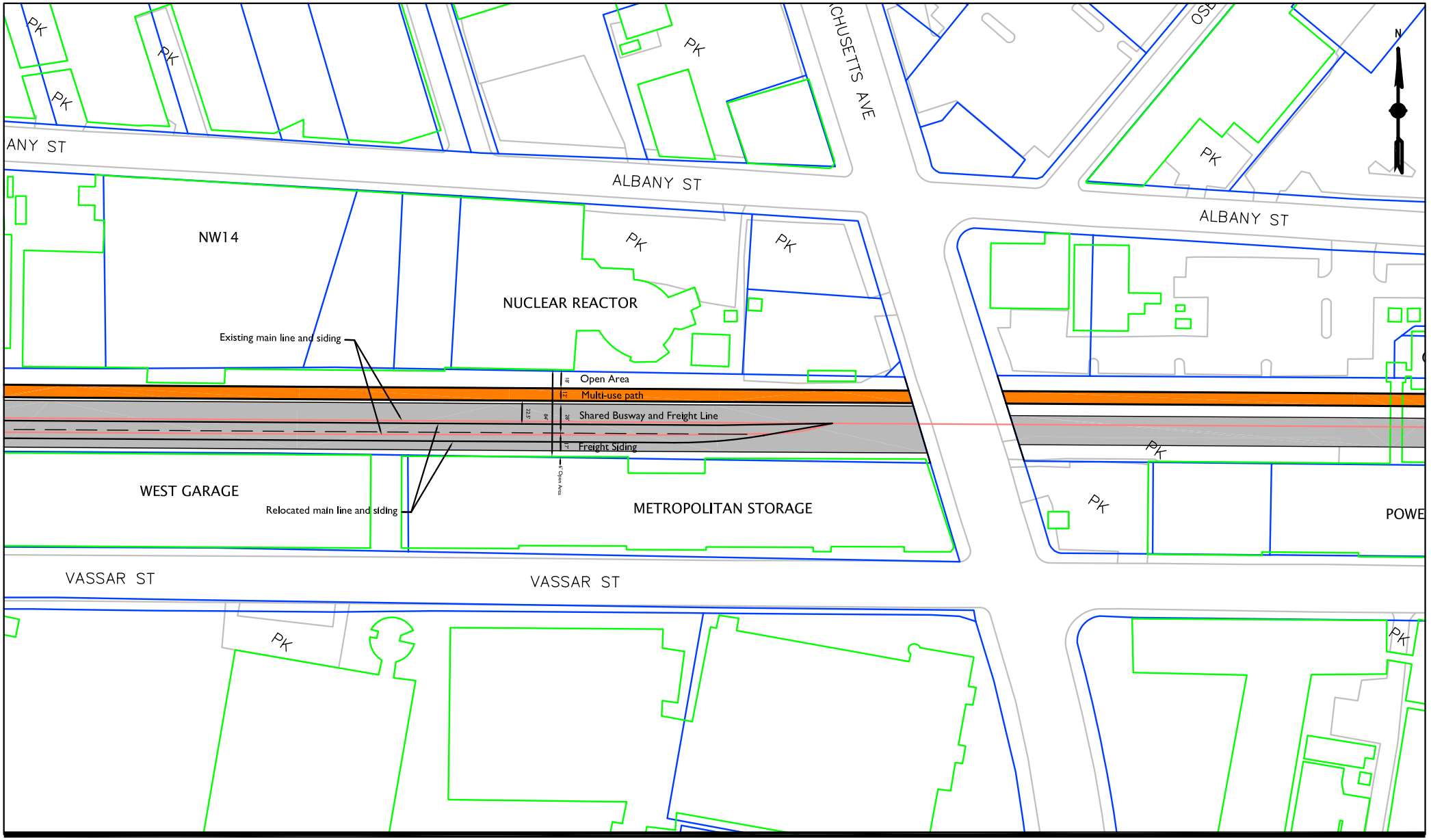
SHEET 3 of 5

Base: City of Cambridge

Grand Junction Rail with Trail

Alternative 2: Urban Ring-Bus Rapid Transit

Cambridge, MA



alta PLANNING + DESIGN

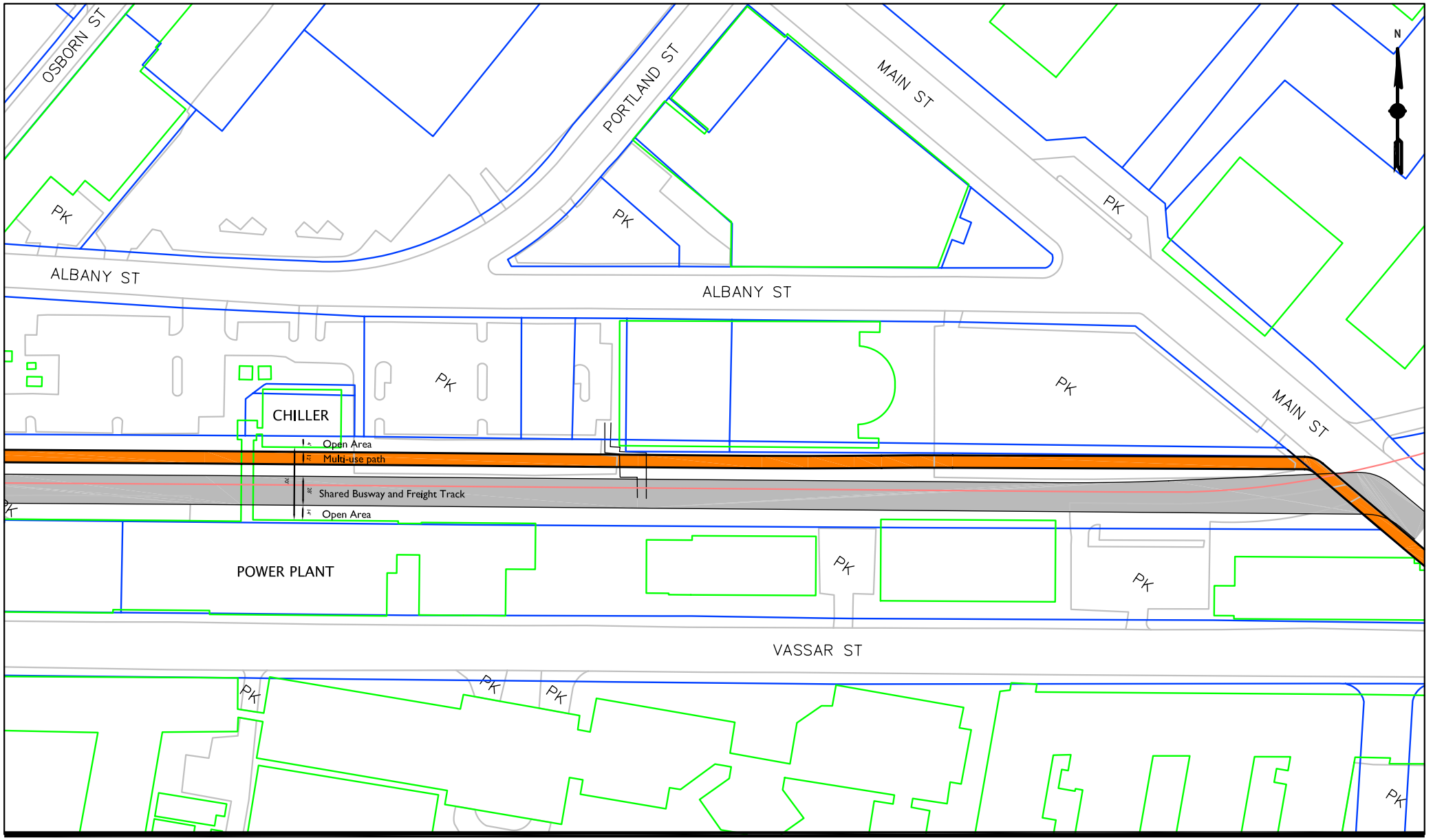
SHEET 4 of 5

Base: City of Cambridge

Grand Junction Rail with Trail

Alternative 2: Urban Ring-Bus Rapid Transit

Cambridge, MA



alta PLANNING + DESIGN

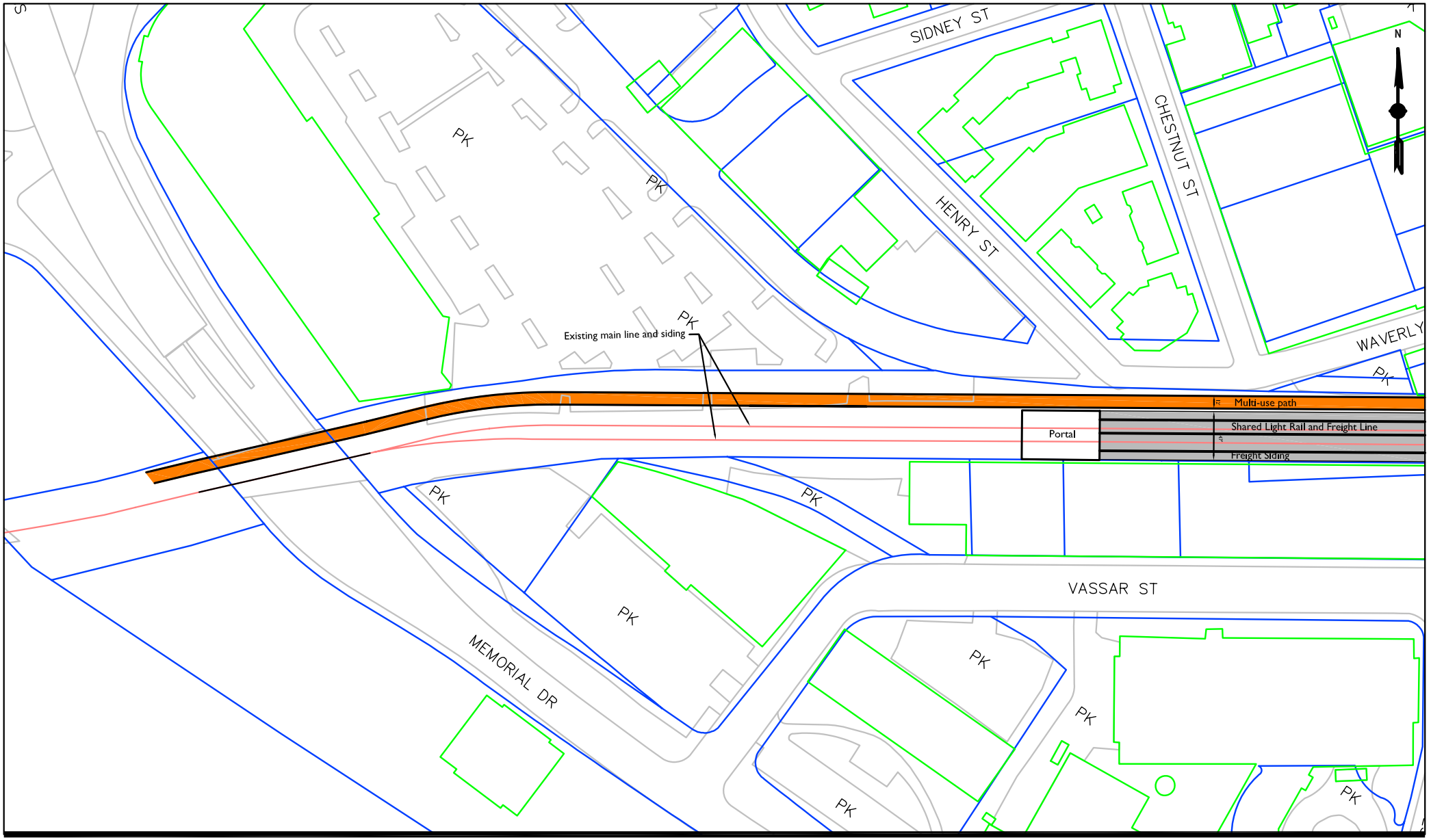
SHEET 5 of 5

Base: City of Cambridge

Grand Junction Rail with Trail

Alternative 2: Urban Ring-Bus Rapid Transit

Cambridge, MA



alta PLANNING + DESIGN

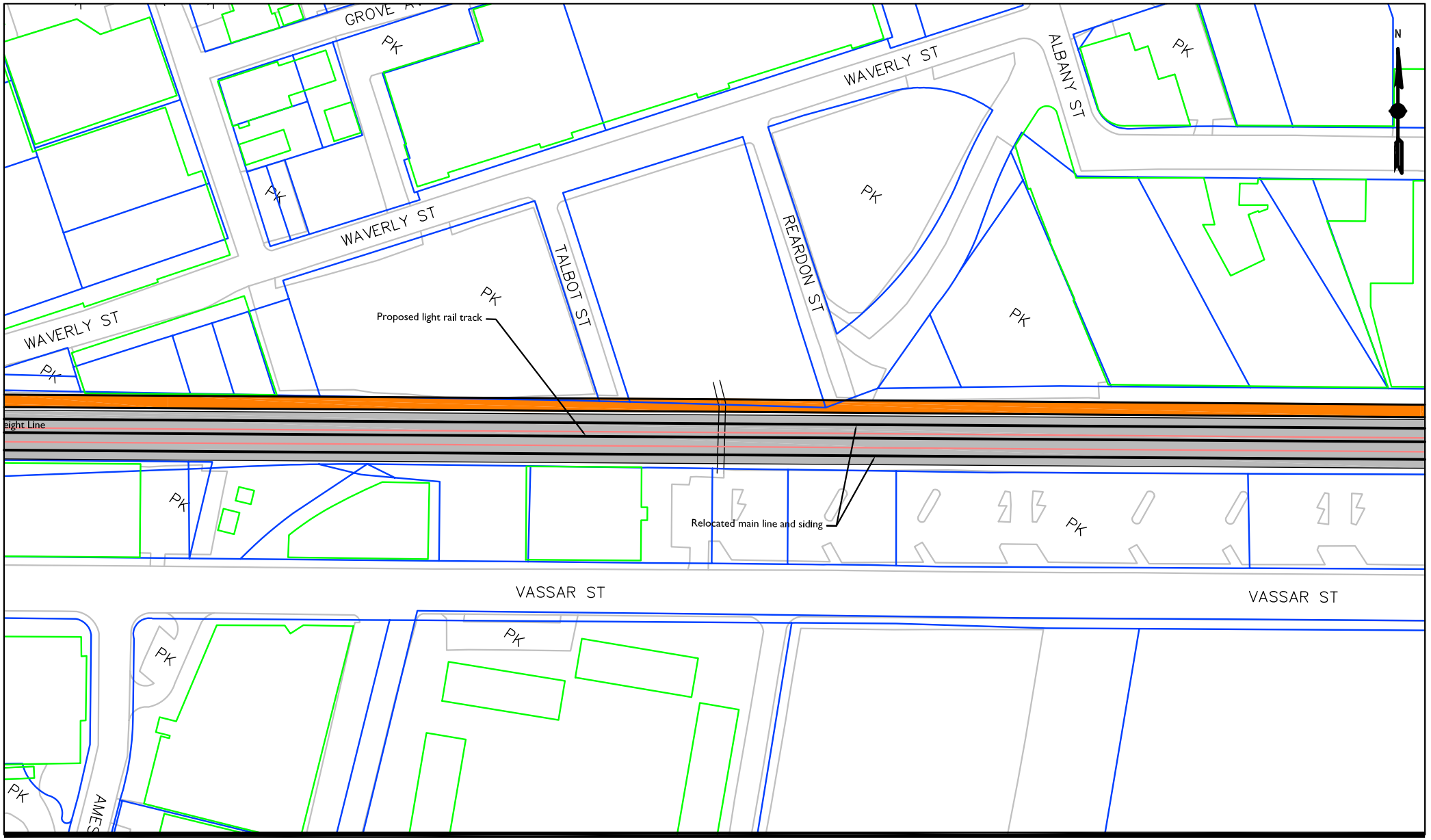
SHEET 1 of 5

Base: City of Cambridge

Grand Junction Rail with Trail

Alternative 3: Urban Ring-Light Rail Transit

Cambridge, MA



alta PLANNING + DESIGN

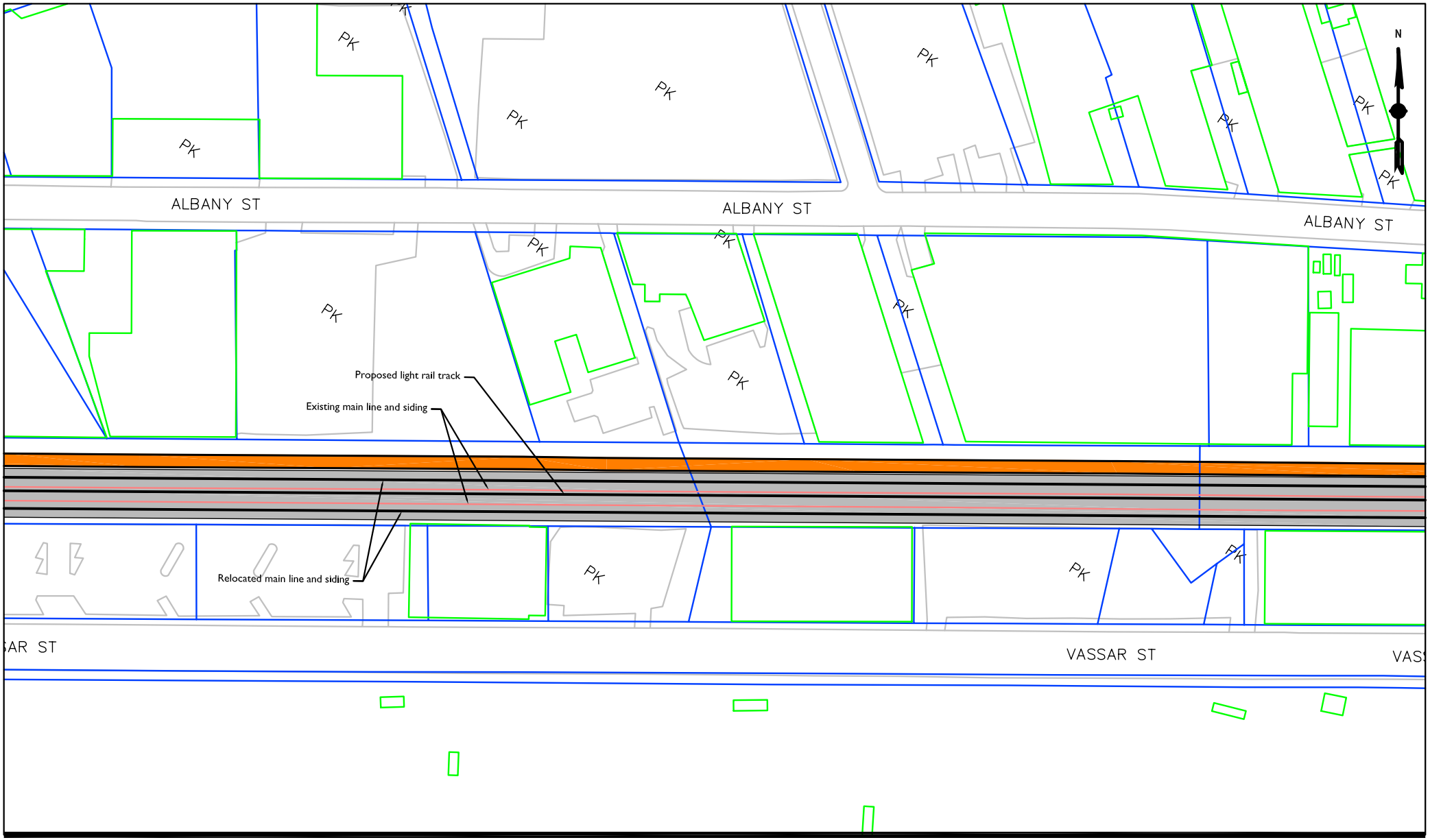
SHEET 2 of 5

Base: City of Cambridge

Grand Junction Rail with Trail

Alternative 3: Urban Ring-Light Rail Transit

Cambridge, MA



alta PLANNING + DESIGN

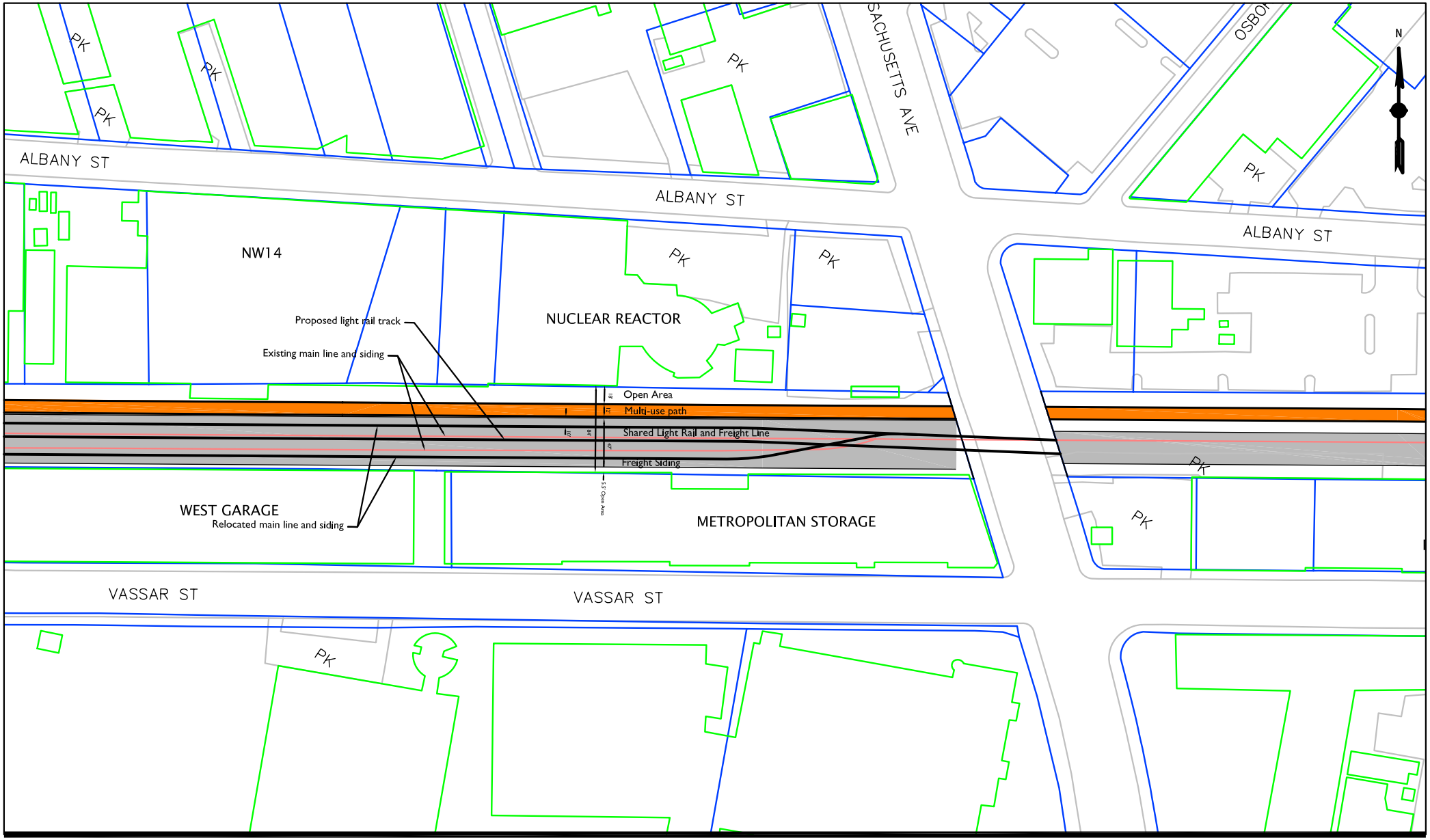
SHEET 3 of 5

Base: City of Cambridge

Grand Junction Rail with Trail

Alternative 3: Urban Ring-Light Rail Transit

Cambridge, MA



alta PLANNING + DESIGN

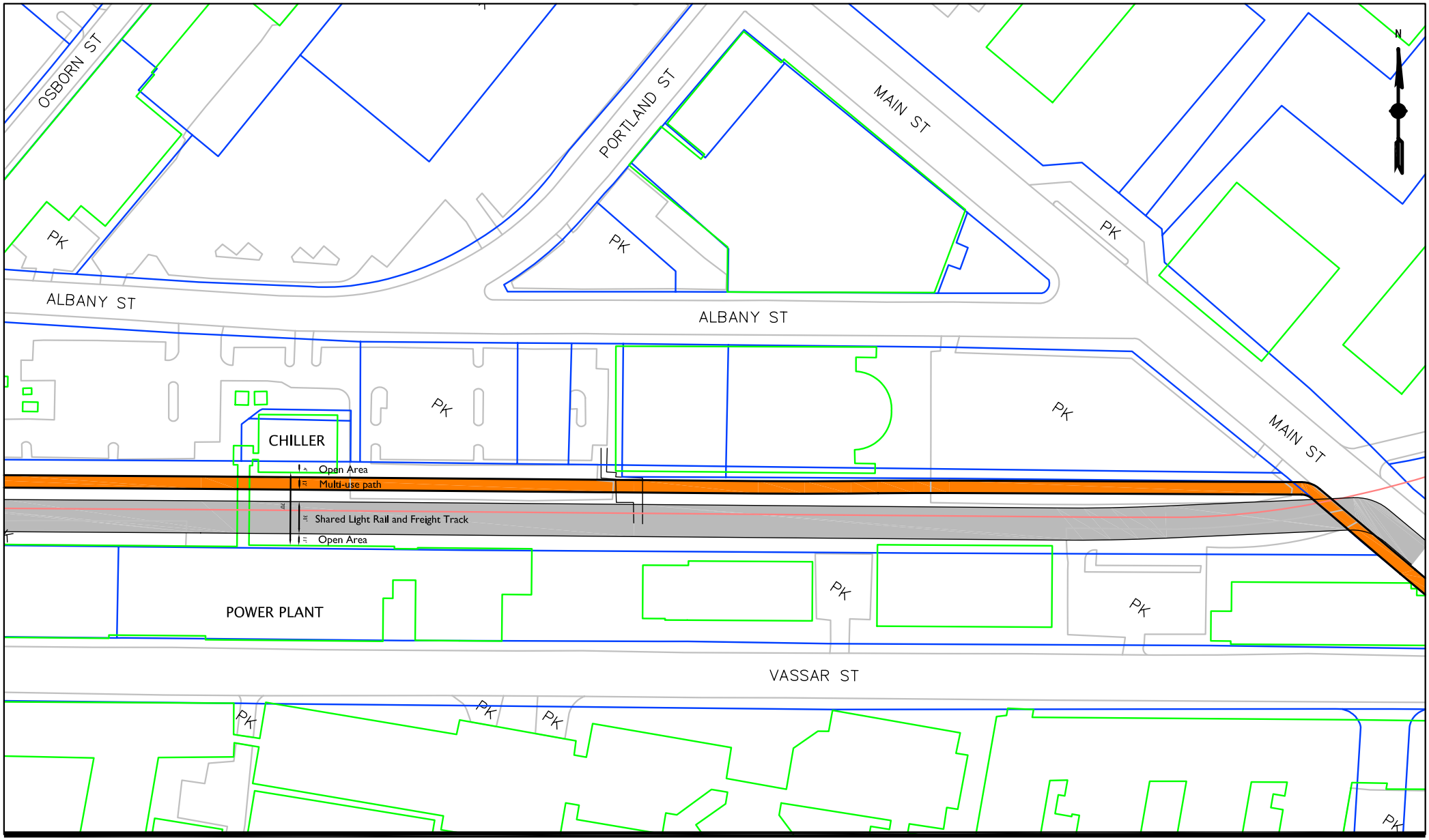
SHEET 4 of 5

Base: City of Cambridge

Grand Junction Rail with Trail

Alternative 3: Urban Ring-Light Rail Transit

Cambridge, MA



alta PLANNING + DESIGN

SHEET 5 of 5

Base: City of Cambridge

Grand Junction Rail with Trail

Alternative 3: Urban Ring-Light Rail Transit

Cambridge, MA

APPENDIX D: COMPARABLE TRAILS

Comparable Trails

The Grand Junction corridor is unique in its features and challenges. Nevertheless, other trails with similar qualities or circumstances as the Grand Junction Trail provide meaningful information and experience.

Burlington Waterfront Bikeway – Burlington, VT 1985

The Burlington Waterfront Bikeway is a paved recreational trail, mostly on a former railbed, that travels from the southern end of Burlington at Oakledge Park to its northern terminus at the mouth of the Winooski River, a distance of over 7.5 miles. The trail parallels an active railroad line for two miles that is barrier controlled by fencing as settled in the contract agreement. The trail supports hundreds of thousands of users each year. The entire corridor is owned by the Vermont Agency of Transportation (VTrans), with the Vermont Railway Company (VTRR), under an easement to VTrans, using the tracks as a switching yard with numerous trains operating throughout the day at a maximum speed of 16 mph.

Burlington Waterfront Bikeway

Duwamish Trail – Seattle, WA 1988

The Duwamish Trail is a 4.5-mile long trail in Seattle, Washington with 1.5 miles of trail parallel to the rail corridor. The trail supports nearly 300,000 annual users. The trail passes through a variety of land uses adjacent to the trail and rail corridor, including industrial (primarily), commercial, and residential. The trail varies in width from 8-10 feet, and is located in an 18-foot wide rail corridor with separation of eight feet between the trail and the track. This separation is not barrier controlled. The trail also has three at-grade crossings of the railroad tracks, which are posted with warning signs. Burlington Northern Railroad operates 2-3 trains per day on the industrial spur with a maximum train speed of 10 mph.

Duwamish Trail

Libba Cotton Bikepath – Carrboro, NC 1982

Libba Cotton Bikepath

The Libba Cotton Bikepath is a short 0.4-mile long path that is used by over 4,000 student bicycle commuters daily to reach the University of North Carolina, Chapel Hill. The Libba Cotton is unique because it is the only rail-with-trail whose corridor is owned by a third party, in this case, UNC-Chapel Hill. The entire bikepath parallels the rail corridor while passing through a commercial district. The rail corridor is 54 feet wide, with a separation of 12 feet between the trail and the tracks. There are no other barriers present at this time. The trail has two marked, at-grade crossings. Norfolk Southern was not opposed to the trail, and they still have a favorable impression of the Libba Cotton Bikepath. They currently operate one train a day on the line, with a maximum speed of 20 mph.

Seattle Waterfront Trail – Seattle, WA 1989

Seattle Waterfront Trail

The Seattle Waterfront Trail is a 0.8-mile long trail in Seattle, Washington that parallels a rail corridor. The trail supports nearly 1,000,000 annual users. The trail passes through a variety of land uses adjacent to the trail and rail corridor, including commercial and residential. The trail varies in width from 8-10 feet, and is located in an 18-foot wide rail corridor with separation of 8 feet between the trail and the track. This separation is barrier controlled by a split rail fence. The trail also has two at-grade crossings of the railroad tracks, which are posted with warning signs. Seattle METRO Transit operates two trolleys per hour with a maximum train speed of 15 mph.

Springwater on the Willamette Trail – Portland, OR 2002

Springwater on the Willamette

The Springwater on the Willamette is a 3-mile long trail in Portland, Oregon that parallels an active rail corridor its entire length. The trail passes through a variety of land uses adjacent to the trail and rail corridor, including residential, industrial, and a wildlife sanctuary. The trail varies in width from 10-14 feet, and has a separation of 10 feet between the trail and the track. A four-foot tall chain link fence controls this separation. The trail has one at-grade crossing that is controlled by signal devices and posted with warning signs. Oregon Pacific Railroad (OPR) runs both short-line freight and excursion trains through the corridor. OPR operates freight trains three times a week in winter and tourist excursion trains fives times a day in the summer, with a maximum train speed of 20 mph.

West Orange Trail – Winter Garden, FL 1994

The West Orange Trail is a 5.5-mile long trail with 0.8 miles of trail paralleling the active rail corridor that starts in Winter Garden and goes up to the Orange/Lake County line. The trail supports over 50,000 users per year. Along the way, the trail passes through residential, commercial, and industrial land uses. The rail corridor is owned by Orange County Parks. The West Orange Trail is 14 feet wide, with a 5-foot separation between track and trail. This separation is controlled by a 4-ft high chain link fence. The trail also has two marked, at-grade crossings of the tracks. CSX operates one train a day on the line, with a maximum speed of 5 mph.

West Orange Trail

APPENDIX E: ENVIRONMENTAL ANALYSIS

Environmental Analysis

The consultants utilized existing in-house reports and Environmental FirstSearch Reports from the project area to prepare this portion of the feasibility study. Many of the reports are in-house at S E A's Cambridge Office and are readily available for future reference.

Based on a desktop review of readily available environmental records, Polyaromatic Hydrocarbons (PAHs), Petroleum Hydrocarbons, and metals are likely present in the surface soils along the proposed route of the bike path.

Table E-1 summarizes several environmental sites that are in the vicinity of the proposed trail route. Sheets 1-7 at the end of this section contain figures depicting the locations of the sites that are summarized in the table. The sites have been identified with letter symbols corresponding to the entries in **Table E-1, left column.** Shaded Rows indicate that additional information for these entries would have to be obtained from the State DEP. Non-shaded rows indicate that information for these entries is readily available from S E A Consultants in Cambridge.

Many of the reports reviewed contained information from local file reviews including City of Cambridge Fire Department and the Cambridge Historical Commission. S E A interviewed MIT personnel in the course of preparing several of the Phase I reports referenced in **Table 3-1.**

One significant report prepared by S E A is entitled "MIT Utility Design and Construction Oil and Hazardous Materials Investigation", dated September 22, 1999. This report contains detailed information about surrounding listed DEP sites, as well as analytical data for all of S E A's subsurface investigations along the CSX Railway and Vassar St. A total of 40 borings were completed along the CSX Railway and Vassar St. between the intersections of Amesbury St. and Vassar St. to the intersection of Main St. and Vassar St.

Table E-1 Summary of DEP Listed Sites

				Prepared by/ Information Source
1-4 of 7 A	9/22/99	MIT Utility Design and Construction Oil and Hazardous Materials Investigation	Along Vassar St. + CSX Railway	S E A Consultants Inc.
				Environmental FirstSearch Report (201 Vassar St. Phase I Report prepared by SE Consultants 1/01)
				Environmental FirstSearch Report (from 201 Vassar St. Phase I Report prepared by S E A Consultants 1/01)

				Prepared by/ Information Source
2 of 7 D	3/4/98	Geoenvironmental Data Report 289 Vassar Street Cambridge, Massachusetts	289 Vassar Street MIT Bldg. W-89	McPhail Associates, Inc.
2 of 7 E	1/99	Report on Preliminary Geotechnical Engineering and Environmental Investigation Proposed Vassar Street Student Housing Massachusetts Institute of Technology Cambridge, Massachusetts	229 Vassar St.	Haley & Aldrich
2-3 of 7 F	1/01	Phase I Site Investigation Report for 201 Vassar St.	201 Vassar St.	S E A Consultants Inc.
3 of 7 G	1/01	Response Action Outcome Statement for Petroleum Hydrocarbons Release on the CSX Railway Right-of-Way RTN 3-19197	Approx. 760 feet West of Mass. Ave. along CSX Railway	S E A Consultants Inc
3 of 7 H	7/28/97	Phase III - Phase III Comprehensive Environmental Site Assessment Report North Side of Johnson Athletic Center 120 Vassar Street Cambridge, MA (RTN No. 3-4032)	120 Vassar Street MIT Bldg W-34	Gemini Geotechnical Associates, Inc.
3 of 7 I	9/98	Preliminary Report on Geotechnical Engineering and Environmental Investigation Proposed Central Athletic Facility Massachusetts Institute of Technology Cambridge, MA (RTN 3-17627)	100 Vassar Street	Haley & Aldrich
3 of 7 J	1/23/98	Immediate Response Action Completion Statement RTN 3-14935 and Phase I Initial Site Investigation Report RTN 3-14935	270 and 290 Albany St.	Clean Harbors Environmental Services, Inc.
3 of 7 K	1/01 12/02	Phase I Initial Site Investigation for CSX Railway West of Massachusetts Ave. RTN 3-19199 and Class A-1RAO Statement	Approx. 240 feet West of Mass. Ave. along CSX Railway	S E A Consultants Inc.
3-4 of 7 L	12/99	Utility Related Abatement Measure Plan and Completion Statement for Utility Installation along CSX Railway.	CSX Railway Easement (Main St. to Mass. Ave)	S E A Consultants Inc.
4 of 7 M	2/11/99	Phase I Limited Site Investigation Building 41A, 73-83 Vassar St. and 133-139 Massachusetts Ave. Cambridge, Massachusetts	73-83 Vassar St. and 133-139 Massachusetts Ave.	McPhail Associates, Inc.
4 of 7 N	1/3/02	Phase I Initial Site Investigation for 60 Albany St. RTN 3-19136	60 Albany St.	S E A Consultants Inc.

				Prepared by/ Information Source
4 of 7 O	10/29/96	Soil Disposition Plan MIT Building 16N Addition Cambridge, Massachusetts	60 Albany St. MIT Bldg N16	McPhail Associates, Inc.
4 of 7 P	4/9/99	Release Abatement Measure Plan (RTN 3-10471) Proposed Albany Street Garage 50 Albany Street Cambridge, Massachusetts	50 Albany St.	McPhail Associates, Inc.
4 of 7 Q	7/8/99	Foundation Engineering Report MIT Building 42 Addition Cambridge, Massachusetts	59 Vassar St. MIT Bldg 42	McPhail Associates, Inc.
4 of 7 R	12/30/98	Subsurface Conditions and Preliminary Foundation Recommendations Proposed Stata Center Massachusetts Institute of Technology Cambridge, Massachusetts	10-40 Vassar Street Former Building 20	Haley & Aldrich
				Environmental FirstSearch Report (from 60 Albany St. Phase I Report prepared by S E A Consultants 1/02)
				Environmental FirstSearch Report (from 60 Albany St. Phase I Report prepared by S E A Consultants 1/02)
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				Environmental FirstSearch Report (from 60 Albany St. Phase I Report prepared by S E A Consultants 1/02)

				Prepared by/ Information Source
				Environmental FirstSearch Report (from 60 Albany St. Phase I Report prepared by S E A Consultants 1/02)

Shaded Rows indicate that additional information for these entries would have to be obtained from the State DEP. Non-shaded rows indicate that information for these entries is readily available from S E A Consultants in Cambridge.

Based upon information gathered from completed field investigations, analytical results, and records review, the following observations apply:

- Reportable Concentrations of PAHs, Petroleum Hydrocarbons, or Metals under 310 CMR 40.000 are likely present in the soils at many of the sites within the route and within close proximity to the proposed trail.
- Evidence of subsurface contamination from both known and unknown sources of oil and hazardous materials was observed or detected in the soil and groundwater samples collected by
  S E A as specified in the report "MIT Utility Design and Construction Oil and Hazardous Materials Investigation", prepared by S E A and included in Attachment 2.
- Due to the strong likelihood of the presence of contaminants, pre-characterization of the soils within the proposed trail should be performed primarily to assess the risk to construction workers, and to verify the presence and concentrations of contaminants. The number of pre-characterization samples necessary would be approximately 20 samples assuming a total trail length of 10,000 feet (1 sample/500 feet). The samples should be tested for arsenic, lead, and extractable petroleum hydrocarbons with target analytes.
- The presence of contaminants in the soil could pose a hazard to both the construction workers and the public welfare during trail construction. The main route of entry of contaminants would be through inhalation (air intake vents on buildings near the proposed bike path, construction workers exposed to dusts, etc.).
- A site-specific Health and Safety Plan (HASP) should be developed based on pre-characterization data to minimize the hazards to construction workers and the public during trail construction.
- Construction methods should be specified to minimize handling soils, to minimize the creation of an excess volume of soils, and to minimize the exposure of soils to construction workers and the public. Possible construction methods would include:

    1. Wetting soils with water prior to excavation to minimize generating dust;
    2. Utilizing excess soils underneath the proposed bike path to the maximum extent possible by raising the final grade of the pathway;

3. Spreading soils with acceptable contaminant levels along the sides of the proposed bike path;

4. Mixing existing soils with structurally supportive soils to make the soils geotechnically suitable for reuse as a base for the proposed bike path to minimize excavation and removal;

5. Stabilizing either side of the proposed bike path with packed stone dust to minimize the public's future contact with the soil;

6. Installing fencing between the existing railroad rails and the proposed bike path to maximize safety of trail users from the railway and to minimize exposure of trail users to surface soils on the railway; and

7. Using landscaping techniques to cover the soils near the proposed bike path, thus limiting the exposure to the public.

- A modest amount of excess soils will likely be generated requiring proper disposal. Any soil destined for disposal must be sampled for full disposal characterization analytical data. It is usually required to characterize each 500 yd^3 of soil for disposal. The concentrations of contaminants in the soil will dictate the method and location for disposal. Approximate costs for disposal of different soils are listed below:

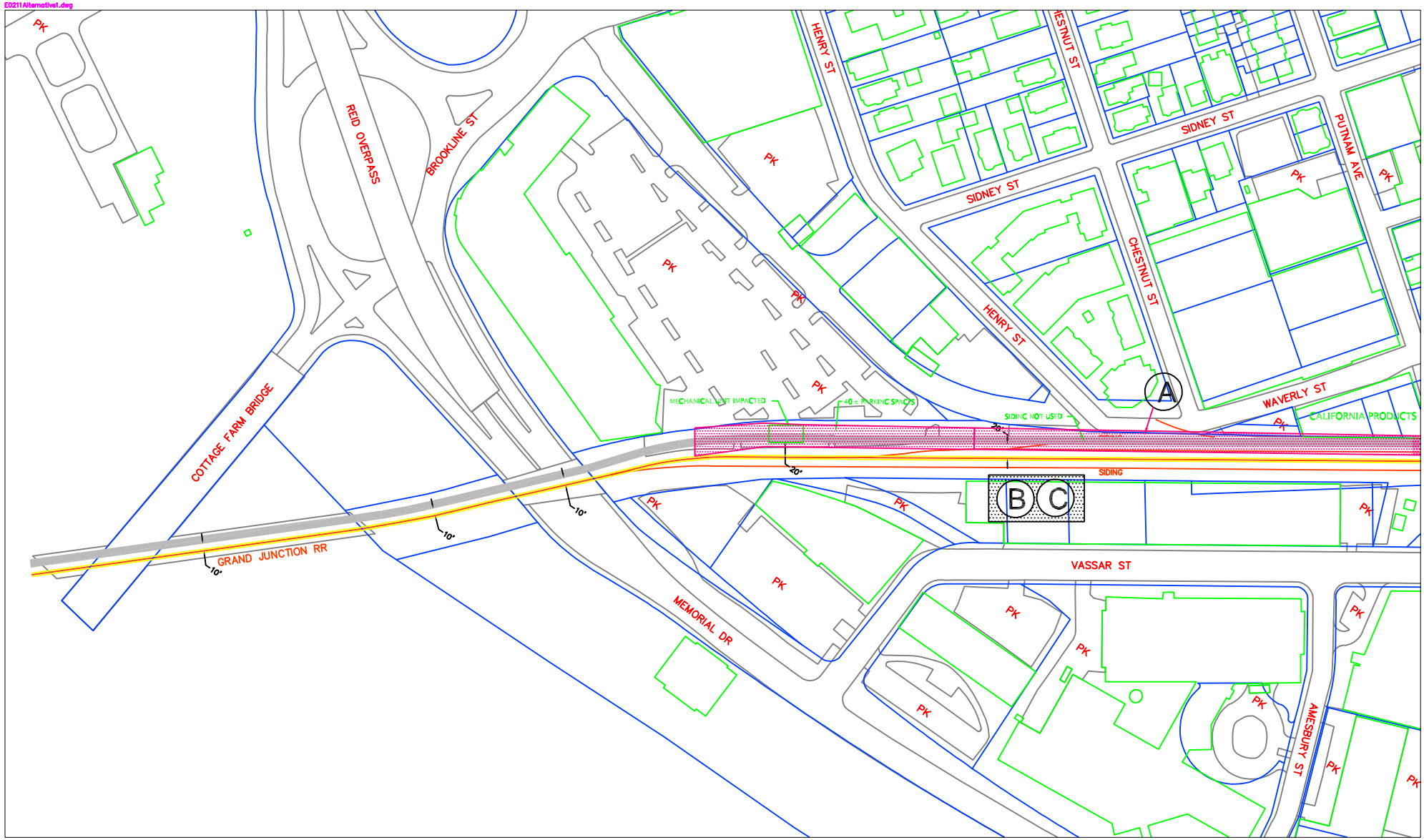
    8. Costs for transportation and disposal at an unlined landfill range from $30-35/ton.

    9. Costs for transportation and disposal at a lined landfill range from $40-45/ton.

    10. Costs for transportation and disposal at an asphalt batch plant range from $45-60/ton.

    11. Costs for transportation and disposal of RCRA hazardous waste is approximately $215/ton.

- The quantity of material disposed will determine the number of samples requiring full disposal characterization at a maximum of 500 yd^3 per sample. Assuming a modest amount of excess soils would be generated, the most cost-effective method would be to stockpile the excess soils accordingly and sample the stockpile for full characterization. The volume of the soil stockpile will dictate the number of samples needed (i.e., 300 yd^3 would require 1 full characterization sample; 600 yd3 would require 2 full characterization samples). The cost for full characterization analytical testing is approximately $800/sample.



KEY

Letters correspond to left hand column of Table E-1

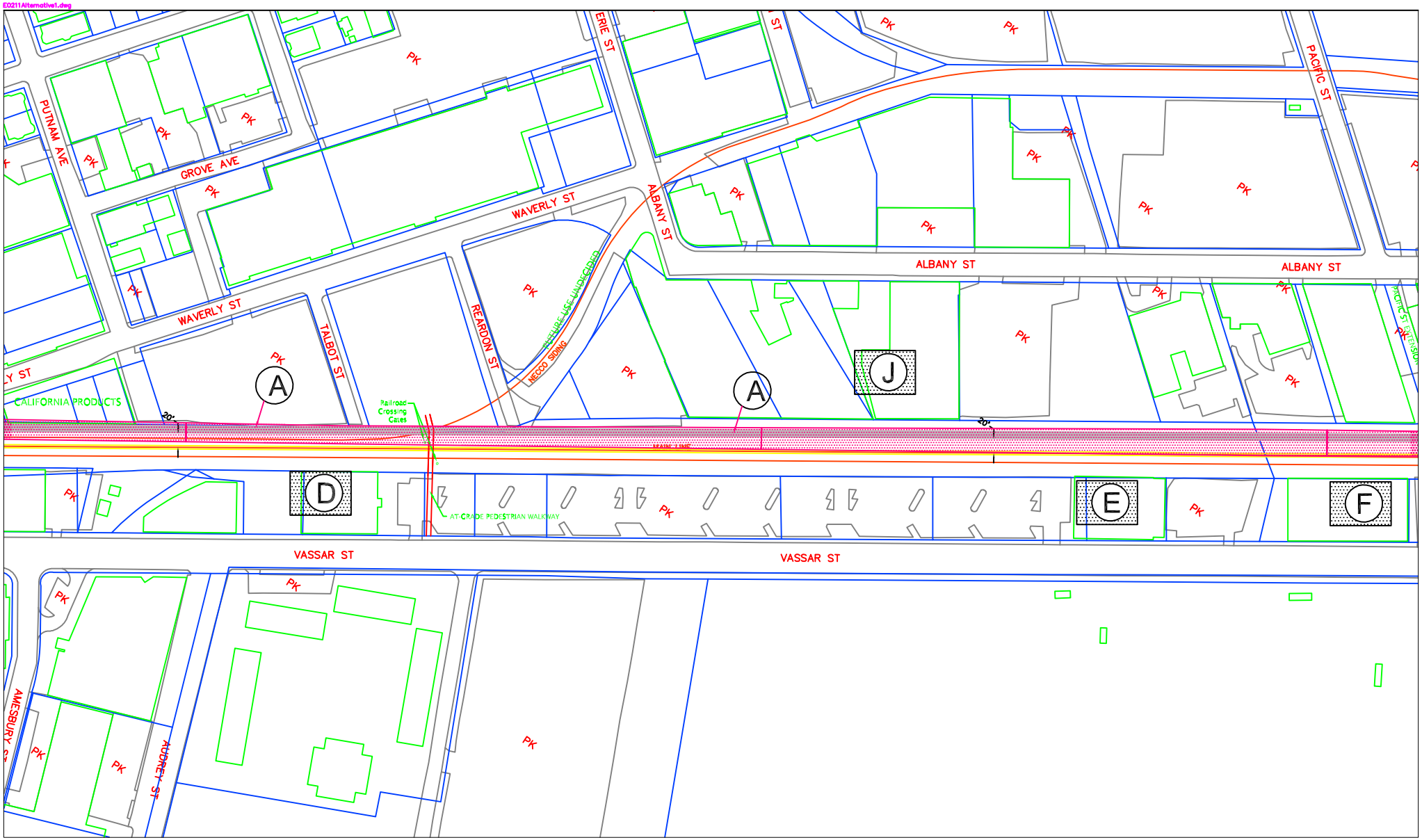
SHEET 1 OF 7
1"=60'

Source: City of Cambridge Community Development Department
*No Urban Ring on Surface in Corridor

Grand Junction Rail with Trail

Alternative 1: Concept Plan*

Cambridge, MA



KEY

Letters correspond to left hand column of Table E-1

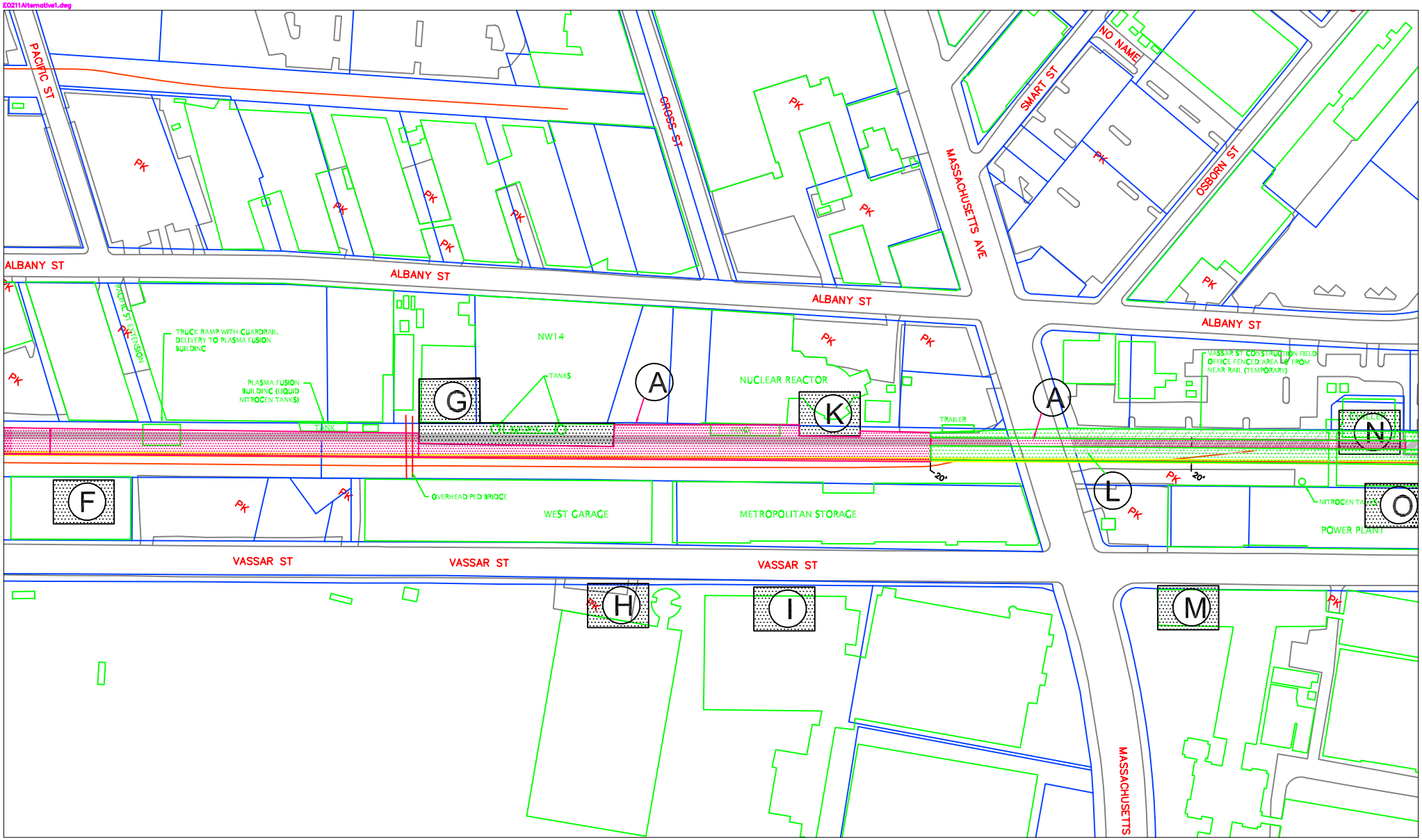
SHEET 2 of 7
1"=60'

Source: City of Cambridge Community Development Department
*No Urban Ring on Surface in Corridor

Grand Junction Rail with Trail

Alternative 1: Concept Plan*

Cambridge, MA



KEY

Letters correspond to left hand column of Table E-1

SHEET 3 of 7

1"=60'

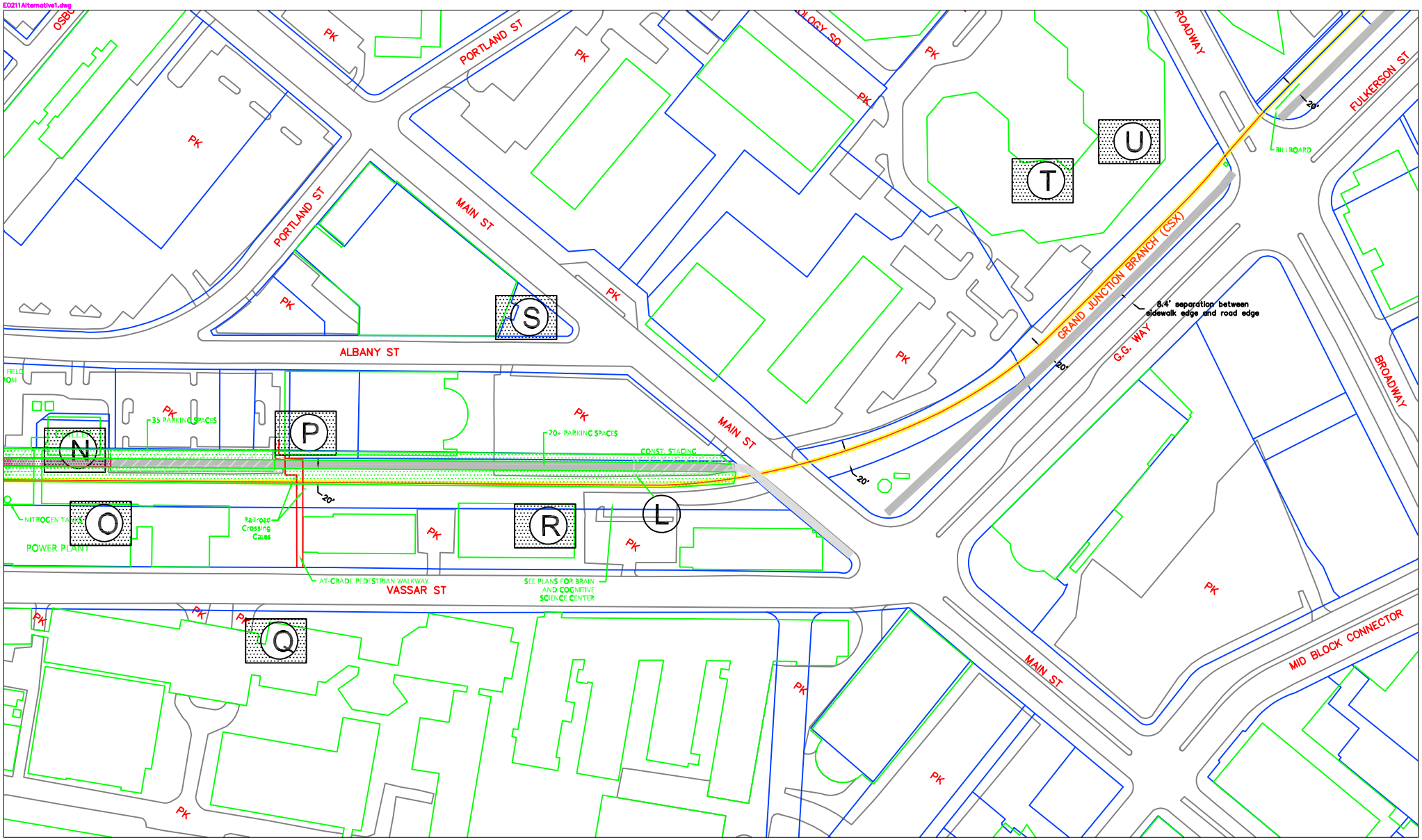
Source: City of Cambridge Community Development Department

*No Urban Ring on Surface in Corridor

Grand Junction Rail with Trail

Alternative 1: Concept Plan*

Cambridge, MA



KEY

Letters correspond to left hand column of Table E-1

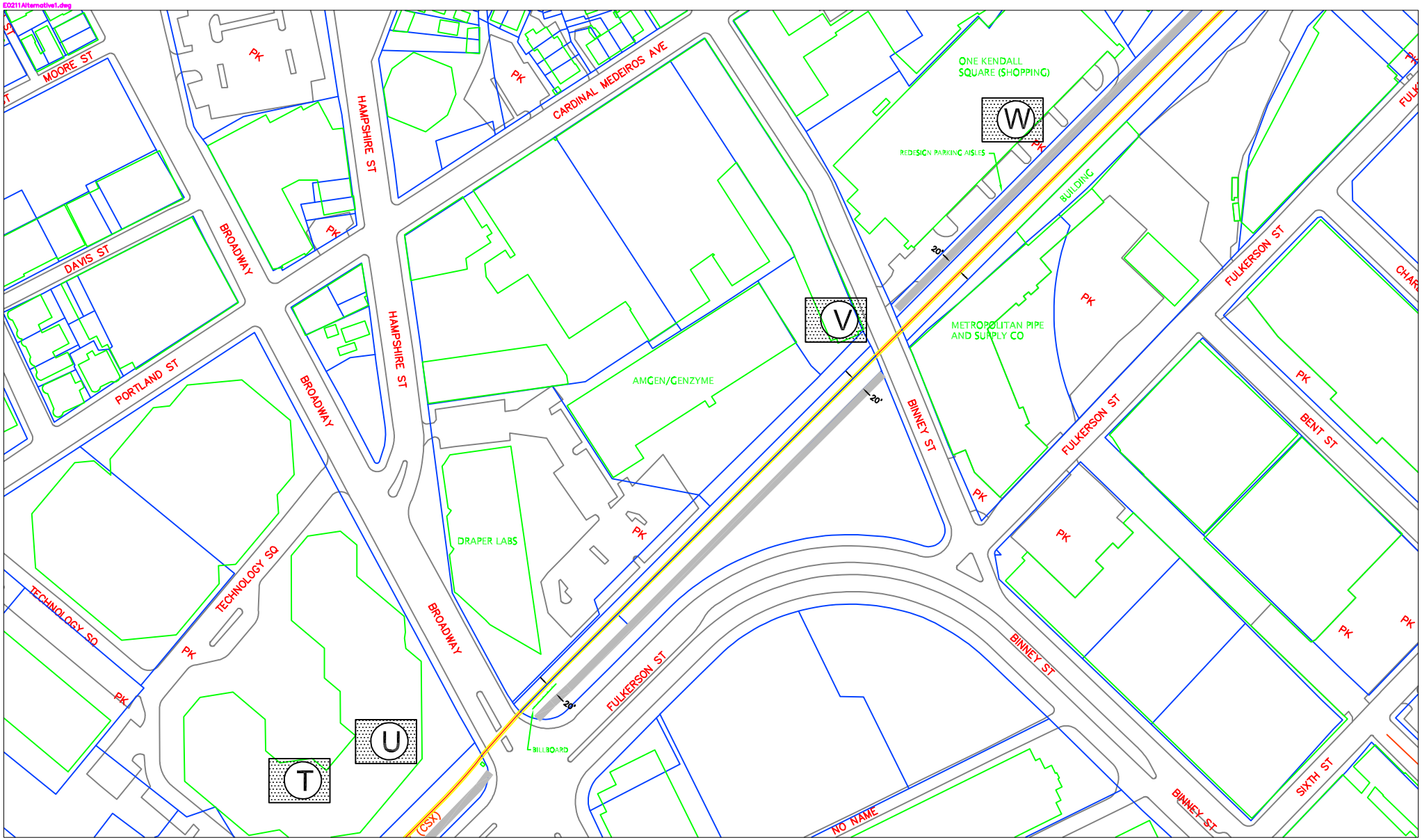
SHEET 4 of 7
1"=60'

Source: City of Cambridge Community Development Department
*No Urban Ring on Surface in Corridor

Grand Junction Rail with Trail

Alternative 1: Concept Plan*

Cambridge, MA



KEY

Letters correspond to left hand column of Table E-1

SHEET 5 of 7

1"=60'

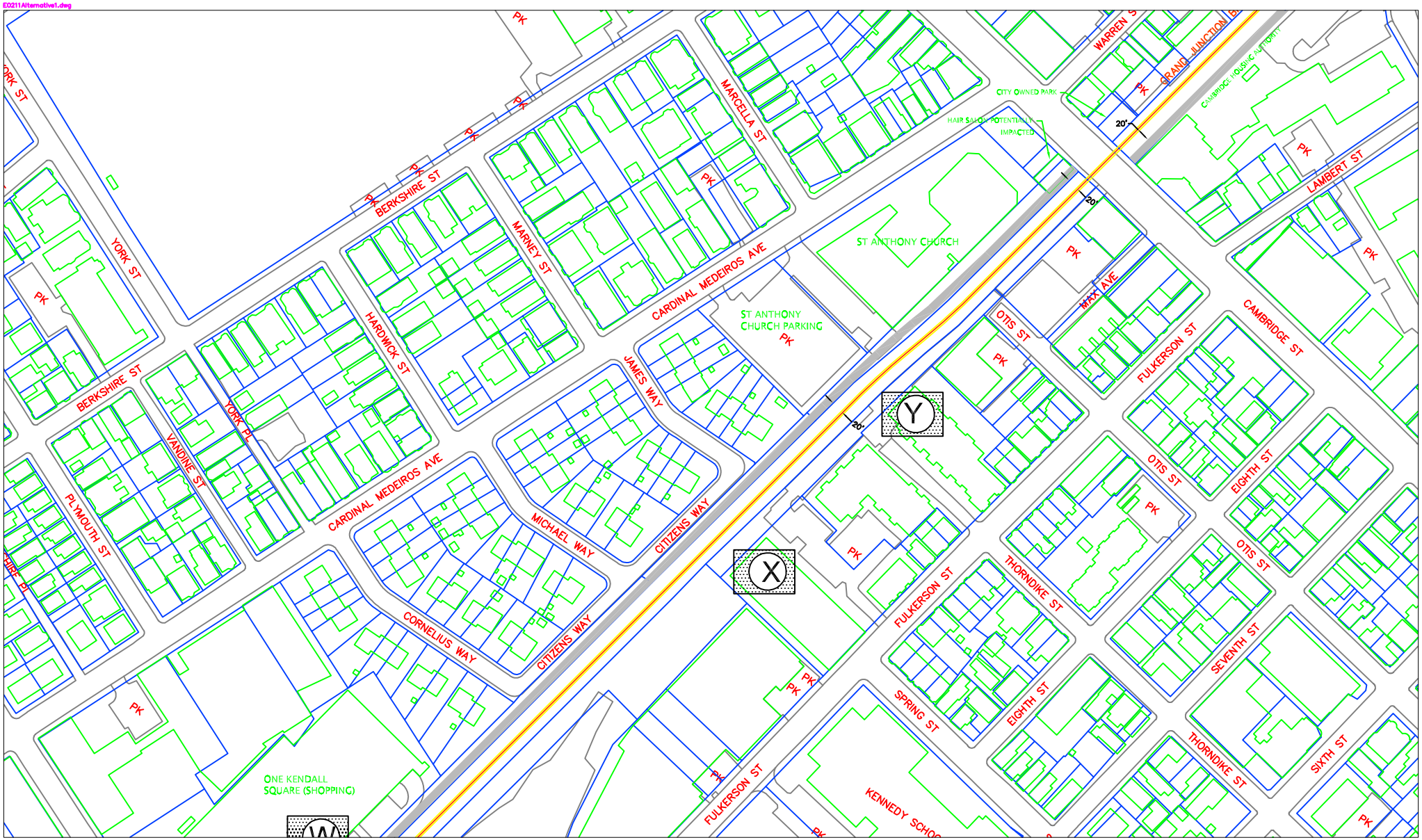
Source: City of Cambridge Community Development Department

*No Urban Ring on Surface in Corridor

Grand Junction Rail with Trail

Alternative 1: Concept Plan*

Cambridge, MA



KEY

Letters correspond to left hand column of Table E-1

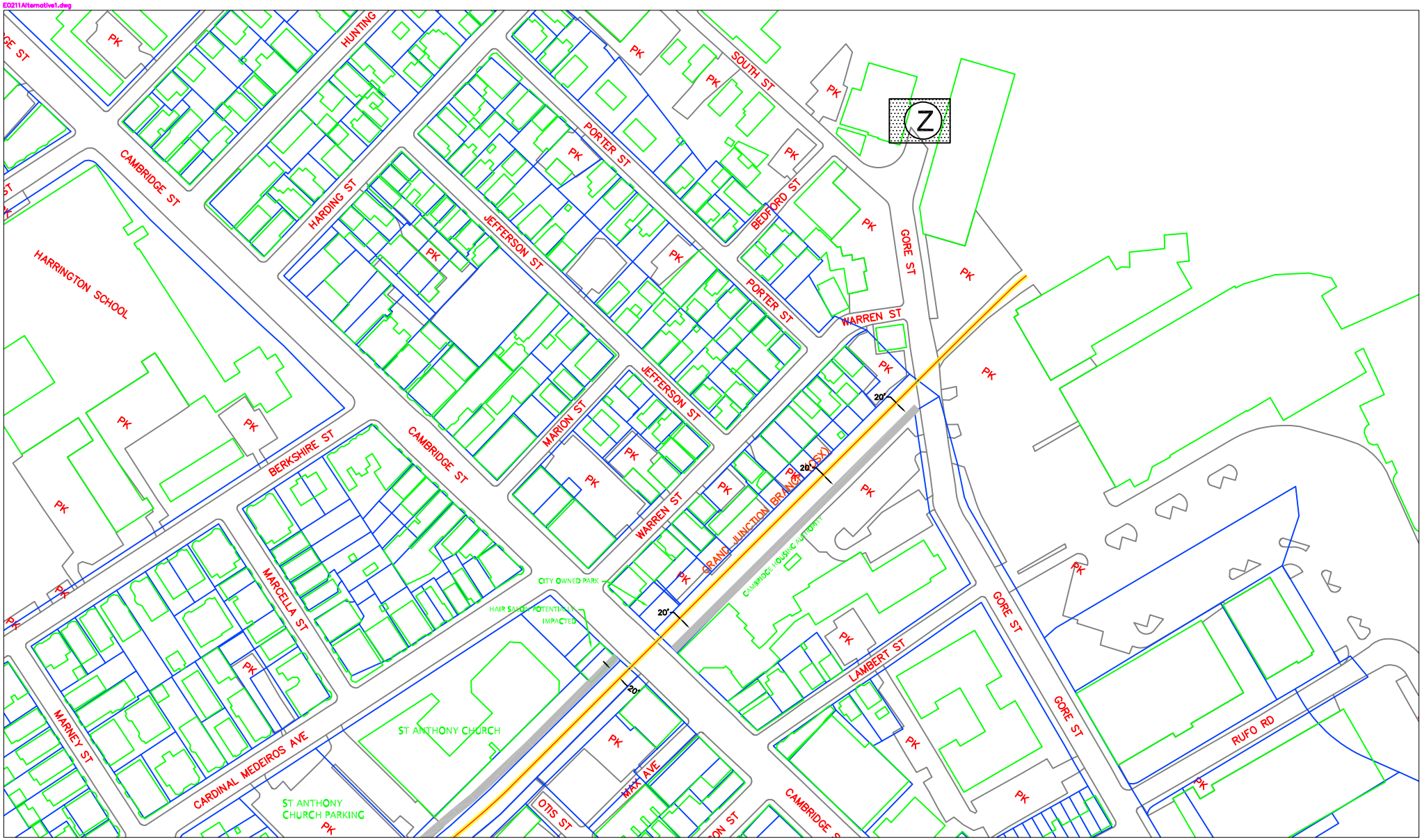
SHEET 6 of 7
1"=60'

Source: City of Cambridge Community Development Department
*No Urban Ring on Surface in Corridor

Grand Junction Rail with Trail

Alternative 1: Concept Plan*

Cambridge, MA



KEY

Letters correspond to left hand column of Table E-1

SHEET 7 of 7
1"=60'

Source: City of Cambridge Community Development Department
*No Urban Ring on Surface in Corridor

Grand Junction Rail with Trail

Alternative 1: Concept Plan*

Cambridge, MA

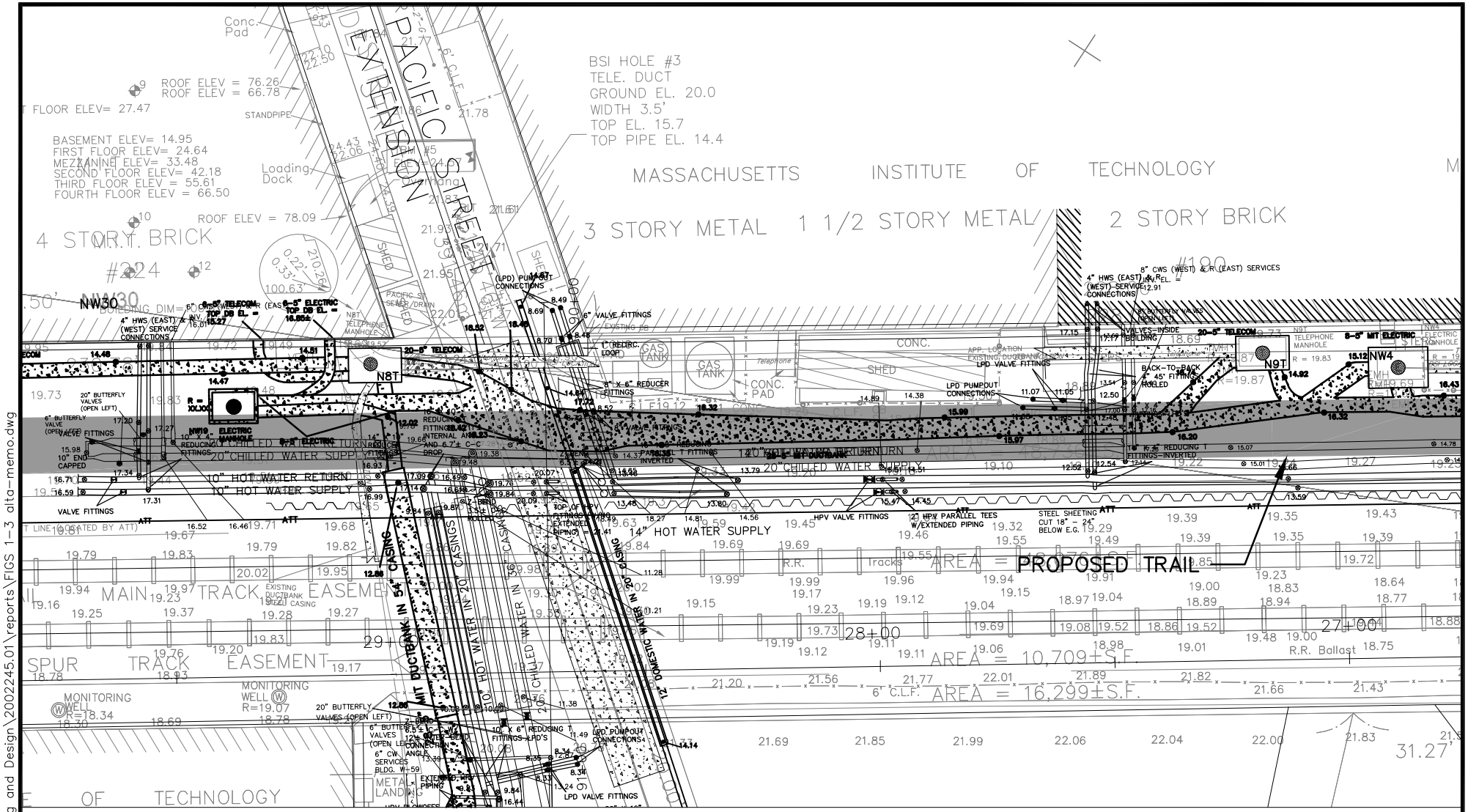


Figure 1

Pacific Street Extension

S E A Consultants Inc.
Scientists/Engineers/Architects

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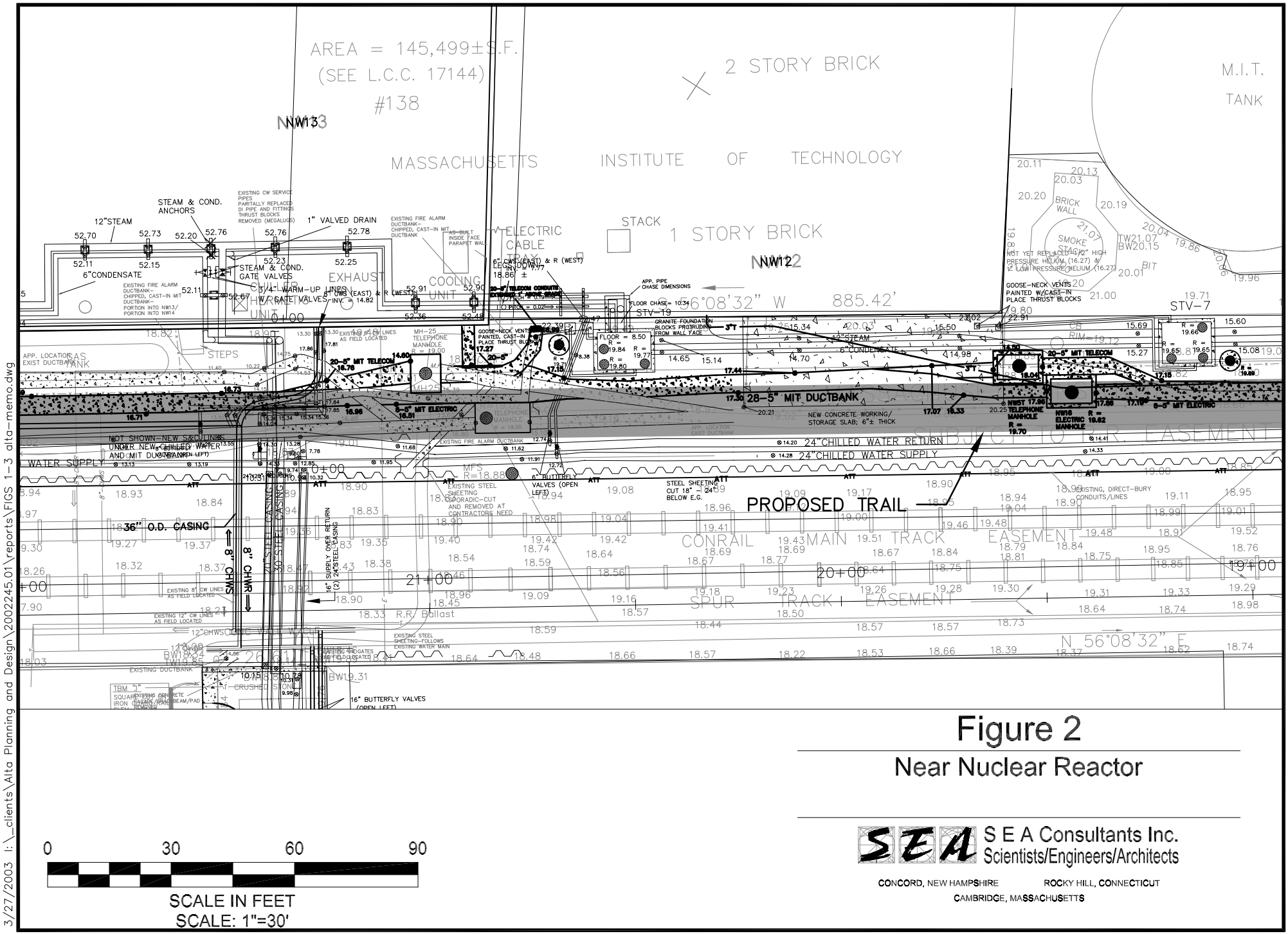
CAMBRIDGE, MASSACHUSETTS



0 30 60 90

SCALE IN FEET
SCALE: 1"=30'

Figure 2

Near Nuclear Reactor

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Scientists/Engineers/Architects

CONCORD, NEW HAMPSHIRE ROCKY HILL, CONNECTICUT
CAMBRIDGE, MASSACHUSETTS

3/27/2003 I:_clients\Alta Planning and Design\2002245.01\reports\FIGS 1-3 alta-memo.dwg

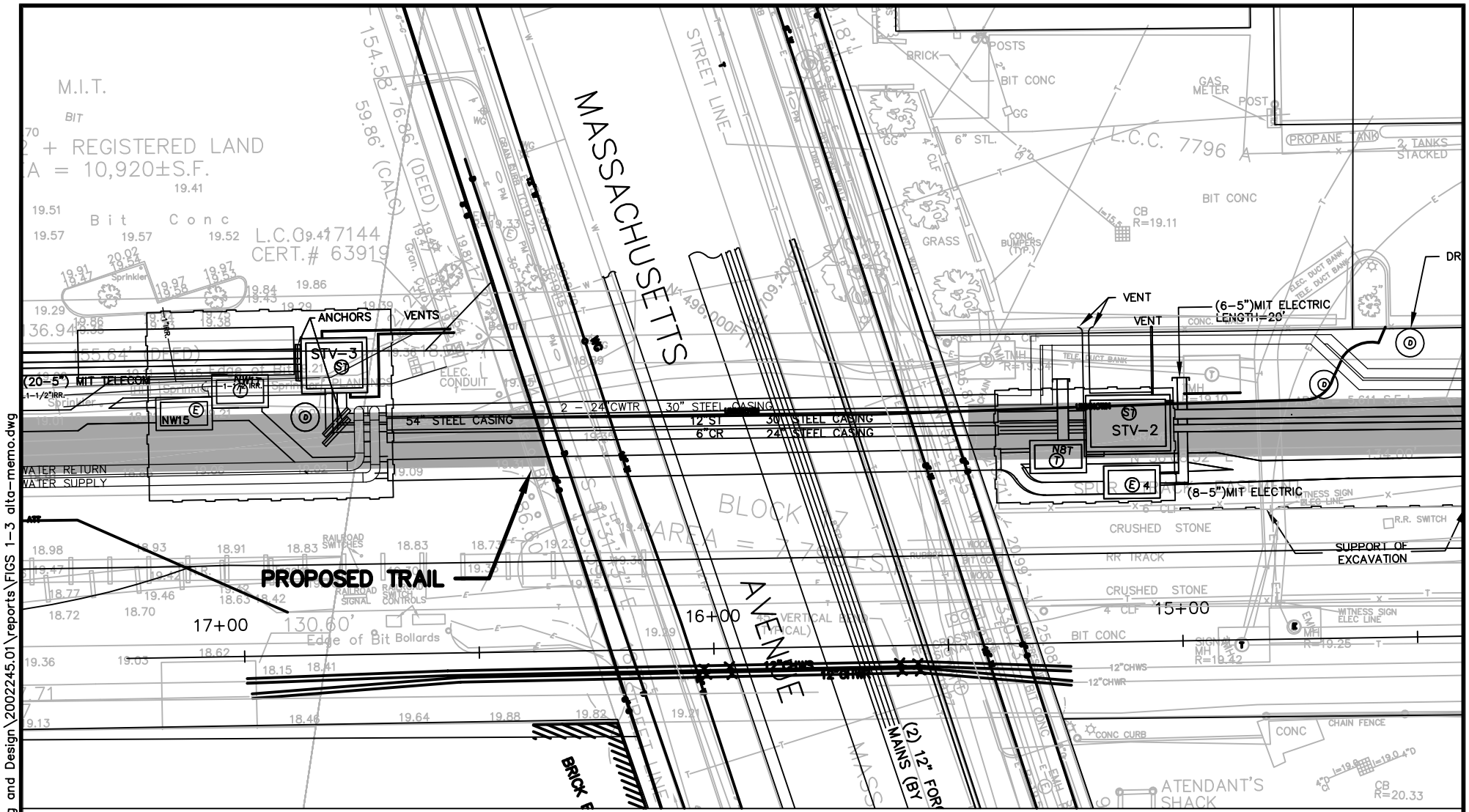

Figure 3

Massachusetts Avenue Crossing

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CAMBRIDGE, MASSACHUSETTS

Figure 4

Between Broadway and Binney

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CAMBRIDGE, MASSACHUSETTS