



MEMORANDUM

TO: District Department of Transportation

CC: Susi Cora – The George Washington University
Eric Selbst – The George Washington University

FROM: Jami Milanovich, P.E.

RE: Square 102B – The George Washington University Museum

DATE: October 26, 2011

INTRODUCTION

The George Washington University (GW) Campus Plan/PUD identifies Square 102B as a potential redevelopment site on campus. Square 102B is located on the northeast corner of the 21st Street/G Street, NW intersection, as shown on Figure 1. The University is moving forward now with the Second-Stage PUD and further processing application for the Square 102B redevelopment. The proposed redevelopment plan calls for the construction of the GW Museum. The Museum will include a new structure and a renovation of the historic Woodhull House. The new museum building will cover a footprint of approximately 7,300 square feet (SF) with two below grade and four stories above grade with a total combined gross floor area of approximately 24,000 SF. The Museum will house gallery and exhibition spaces including a high bay gallery and will provide learning and educational facilities. In addition, there will be library facilities, staff offices, and collections processing.

In addition to the new museum, the University also will construct an approximately 20,000 SF conservation and resource center on its Virginia Science and Technology Campus (VSTC) in Ashburn, Virginia for the study and care of Museum's collections. This center will include storage facilities, a conservation laboratory, and facilities for access to the collections. Importantly, this center will help facilitate deliveries to the new museum on the Foggy Bottom Campus by allowing the University to coordinate and consolidate deliveries from various off-site locations, and use smaller vehicles for these deliveries.

There is no existing alley network in Square 102, and the interior of the square is characterized by a large pedestrian-oriented network of pathways and open space known as the University Yard. Therefore, in order to adequately serve the loading needs of the GW Museum, a curb cut is proposed on 21st Street to access the Museum's loading facilities. In order to minimize vehicle/pedestrian conflicts and the use of the curb cut by unintended vehicles, the University is exploring a number of options, including on-site personnel to direct trucks backing into the loading berth and the use of movable bollards, a gate, or a portable ramp.

In addition, the University also proposes to remove approximately three parking meters on the east side of 21st Street, in front of the entrance to the museum, to accommodate the pick-up/drop-off operation for the museum patrons.

As requested at our meeting on July 29, 2011, this memorandum describes the unique need for the proposed curb cut on 21st Street, provides a summary of the potential loading options, and evaluates the appropriateness of the proposed curb cut design and location.

MUSEUM OPERATIONS

Overview

The Museum will showcase a wide variety of priceless artifacts, including but not limited to 3,000 year old tapestries, invaluable works of art, sculptures, and irreplaceable pieces of history. Therefore, care in transporting these items from the delivery vehicle into the Museum is of the utmost importance. In order to ensure the safekeeping of these national and international artifacts, it is imperative that they be protected from the elements in a secure, temperature- and climate-controlled environment. As such, the proposed building has been designed to include a loading berth, which will enable the majority of delivery vehicles to back into the berth (located inside the building) to unload/load the items within the climate-controlled building.

Educational Programs

The Museum's programs will include both the existing program of The Textile Museum, currently located at 2320 S Street, NW and new and existing museum and academic activities of the University, all designed to further the educational mission of the institution. The programmatic elements of the building are still in development, but are anticipated to include lecture series, teacher workshops, drop-in tours, hands-on children's activities, and other traditional museum activities. Deliveries for these types of programs are anticipated to average less than once per week.

Exhibitions and Object Preservation

The GW Museum will feature five galleries with rotating exhibitions, which will include exhibitions from the existing Textile Museum (which will become part of the GW Museum) as well as GW's own collections.

- It is anticipated that collections from The Textile Museum will include four to six exhibitions of various sizes and themes that will change from time to time, as further delineated later in this document. Textile collections may range from contemporary to ancient weavings, art, fabrics, costumes, and rugs. These objects are fragile in nature and as such, exhibits typically are displayed for shorter periods of time and do not utilize a "permanent collection" area often seen in other museums.
- The GW Museum will also feature changing exhibitions of GW's own collections, including the Albert H. Small Washingtoniana Collection, bringing the average number of exhibitions to eight to ten.

It is expected that each of the exhibitions in the five galleries would rotate a minimum of two times per year.

The set-up and take-down for each exhibition will require the transportation of the collections for each exhibition as well as the related display and installation materials, such as exhibit cases, informational displays, and other components tailored to its specific requirements of each exhibition. These displays will be fabricated at the storage and conservation center in Virginia or other off site locations.

Note that, on occasion, the Museum will display large-scale international loan exhibitions (approximately once every two or three years). These exhibits typically are designed and managed by significant domestic

and international institutions, such as the Metropolitan Museum of Art, and the terms of these shows often require door-to-door delivery and frequently do not permit intermediate stops. Therefore, these shows likely would be required to arrive directly at the Foggy Bottom building without stopping at the conservation and storage center in Virginia. In these cases, the large trucks will require a curb side loading zone, and the artifacts will be transported in special climate-controlled containers to protect them from the elements during the loading and unloading processes. (The University will obtain proper permits from the District Department of Transportation to establish a temporary no parking zone on 21st Street adjacent to the building to accommodate these infrequent special deliveries.)

In addition to the specific set-up and take-down of exhibitions, it is anticipated that routine trips will take place once per week between the GW Museum and the conservation facility in Virginia for routine object movement, exhibition maintenance, and similar activities. Again, such active management of the collections is necessary given the fragile nature of the artifacts on display.

Special Events

Occasionally, the Museum will host special events, which may require catering deliveries, equipment deliveries, and deliveries in smaller vehicles, including pick-up trucks and vans. Though these special events will not occur on a regular basis, they will be planned and scheduled events. As such, the deliveries required for each of these events will be scheduled so that they will not conflict with other deliveries occurring at the Museum.

Anticipated Typical Delivery Activities

Table 1 displays the typical delivery activities associated with the educational programs, exhibits, and special events.

Table 1
 Anticipated Typical Delivery Activities

Delivery	Frequency	# of Delivery Trips		Total Annual Deliveries
		Exhibit Set-up	Exhibit Tear-down	
Small Exhibitions (approx. 2,500 SF)	2/year	2 in, 2 out	2 in, 2 out	8
Medium Exhibitions (approx. 5,000 SF)	4/year	6 in, 6 out	6 in, 6 out	48
Large Exhibitions (approx. 10,000 SF)	2/year [†]	9 in, 9 out	9 in, 9 out	0 to 36
VSTC – FB object movement	52/year	1 in, 1 out		52
Educational Programs	40/year	1 in, 1 out		40
Special events/catering	12/year	2 in, 2 out	2 in, 2 out	48
Total				196 to 232

[†] Large exhibitions will not occur every year. It is anticipated that they would occur every two or three years. On a year when a large gallery exhibit does not occur, the number of deliveries associated with this type of exhibit would be zero. During a year when a large gallery exhibit does occur, the number of deliveries associated with this type of exhibit would be 18 per exhibit (for a maximum of 36 if two exhibits occur in the year). Also note that these large scale shows would occupy several gallery spaces within the Museum and, correspondingly, likely would reduce the frequency of gallery turnover for smaller exhibitions during that particular period.

With object movement and deliveries it is estimated that on average the loading berth would be utilized four times per week on average. However, during set-up or tear down of the exhibits, multiple deliveries will occur on the same day.

In addition to the loading berth deliveries, FedEx and UPS deliveries are expected to occur on the order of one delivery per day. While these deliveries could be accommodated via the loading berth, it is anticipated that these deliveries would be made from the proposed no parking zone in front of the building.

Additionally, trash and recycling pick-up are anticipated to occur twice per week. The trash and recycling pick-up will occur curbside, consistent with other University buildings.

Finally, the University anticipates a number of elementary or high school student and adult tours that will arrive in buses. Information from staff indicates that 26 student groups and 15 adult/senior groups are anticipated per year. The student groups will arrive in a school bus and typically take approximately 30 minutes to load and unload students. The adult/senior groups typically arrive in a 30-seat mini-coach bus and take approximately 40 minutes to load and unload. The arrivals and departures of these tour groups will be coordinated by the University (similar to coordination for other campus facilities, such as Lisner Auditorium) and will take place curbside in the planned pick-up/drop-off zone in front of the Museum.

POTENTIAL LOADING OPTIONS

Section 31.2.3.1 of the District Department of Transportation – Design and Engineering Manual outlines the guidelines for curb cuts and driveways. The manual has the following general requirements for the location of such entrances:

A new curb cut or driveway shall not be permitted from any property with alley access or with potential access through an alley widened onto private property or with potential access to an expanded alley network on private property unless the applicant provides documentation that demonstrates that alley access is not possible due to topography or that alley access would be in conflict with existing land uses and not supported by guidelines in the Comprehensive Plan.

Here, there is no existing alley network in Square 102. Rather, it contains a large pedestrian-oriented network of pathways and open space known as the University Yard. As a result, the creation of new alley access would conflict with existing uses. A full examination of this alternative, as well as the proposed curb cut on 21st Street, follows below.

Existing Curb Cut on H Street through the University Yard

Per the request of OP and DDOT, the University directed its consultants to evaluate the feasibility of trucks accessing the site through the University Yard by way of H Street. Under this alternative, trucks entering and exiting the site would be required to traverse the University Yard. Note that for purposes of this evaluation, we have assumed that the existing curb cut from H Street into the University Yard would be relocated from the east side of the Yard to the west side of the Yard to minimize the intrusiveness on the Yard. Figures 2A and 2B illustrate the truck ingress and egress through the Yard.

In this area, H Street is designated as a collector street and carries an average daily traffic (ADT) volume of 4,800 vehicles per day. H Street is a two-way roadway with one travel lane in each direction. Parking is permitted on both sides of the roadway. As shown on Figure 3, no bus routes are present on H Street in the vicinity of the site.

The University Yard serves as the University's primary open space on the Foggy Bottom Campus. As shown on Figure 4, the University Yard is a pedestrian space used for special events and for both active and passive recreation by students, faculty and staff, and the community at-large. During field visits to the site, the following activities were observed on the University Yard:

- Daycare students playing in the Yard,
- GW students playing football in the Yard,
- Beginning of the school year activities, with numerous tables and chairs set up throughout the Yard,
- GW students reading, studying, eating, or resting on the benches located throughout the Yard, and
- Students, faculty, staff, and others walking through the Yard en route to their destination (either in one of the buildings on the square or at other locations on campus).

In addition, numerous special events, which crowd the Yard with pedestrians, take place on the Yard including but not limited to: concerts, Fall Fest, Spring Fling, Alumni Weekend, and events such as Taste of GW.

Figure 5 depicts the buildings surrounding the University Yard by type of use (academic, office, residential, retail, etc.). Pedestrian pathways also are shown on Figure 5. As shown, the University Yard is a logical shortcut for pedestrians between and around several nearby buildings. Furthermore, the Yard encompasses key accessible routes to Corcoran Hall, Lisner Hall, and Lerner Hall. In fact, the only accessible entrances to Corcoran Hall and a portion of Lerner Hall are via the Yard. Figure 6 shows the entry and exit points, including accessible entrances and exits, for the buildings around the perimeter of the Yard.

A pedestrian count study was conducted regarding activity in the Yard, and is discussed in detail below. Based on the observations above regarding the use of the Yard as well as the findings of the pedestrian counts, the introduction of trucks into this activity hub potentially would pose significant safety concerns.

In addition to the pedestrian issues cited above, the University Yard also is home to a significant number of mature trees that would be impacted if the museum deliveries occurred through the Yard, as detailed in the attached arborist's report.

Based on the many conflicts and potential safety hazards, the University Yard was eliminated as a viable alternative for truck access to the site.

Proposed Curb Cut on 21st Street

A 14-foot wide curb cut is proposed on 21st Street near the northern end of the building. As proposed, trucks will back from 21st Street into the curb cut and into the building to do the necessary loading or unloading. When not in use, the loading area will be hidden from view by a sliding door. Figure 7 illustrates the proposed truck circulation with photographs illustrating the context of the curb cut. Figures 8A through 8D show the truck turning diagrams for the proposed curb cut.

In the vicinity of the site, 21st Street is classified as a collector street and carries an ADT of 6,400 vehicles per day. 21st Street is one-way southbound and has two travel lanes and a parking lane (with meters) on the east side of the street. The western lane restricts parking from 7:00 AM to 6:30 PM; therefore, during the daytime hours, two travel lanes are present on 21st Street. From 6:30 PM to 7:00 AM, one travel lane is present. As shown on Figure 3, no bus routes are present on 21st Street in the vicinity of the site.

The proposed curb cut will require the removal of approximately three metered parking spaces on the east side of 21st Street (in addition to the three spaces that are proposed to be removed in front of the museum entrance).

The proposed curb cut on 21st Street will be compliant with the guidelines outlined in section 31.2.3.1 of the District Department of Transportation – Design and Engineering Manual. The manual has the following requirements for general driveways:

- *Driveway entrances should be constructed perpendicular to the curb line of the street through the entire public space area to the property line.*

As shown on Figures 8A through 8D, the driveway will be perpendicular to the 21st Street curbline.

- *All driveways must be flush with the grade of the sidewalk when crossing the entire sidewalk area. The sidewalk area may start a minimum of three feet from the roadway curb line. No step-down curbs or ramps are allowed.*

The proposed driveway will be constructed such that the driveway will be flush with the sidewalk thus negating the need for step down curbs or ramps in the sidewalk area.

- *The grade of any driveway within the public space shall not exceed 12 percent.*

The proposed driveway grade will not exceed 12 percent.

- *A curb cut and/or respective portion of the driveway, including the flare or radius at the curb cut, shall be located within the public space abutting the same lot with the building or structure it is intended to serve.*

As shown on Figures 8A through 8D the proposed curb cut, including the radii will lie entirely within the subject property.

- *Sight-distance when exiting a driveway or parking garage requires a minimum 15 feet distance from the edge line of the driveway on a 45-degree angle from the property line or garage exit, as applicable, to the back edge line of the sidewalk. Within this area, no over-height fencing and/or shrubbery over 4 feet tall are allowed, excluding city trees.*

No objects over four feet tall (excluding city trees) will be provided within the sight triangle.

- *No driveway entrance or exit on any roadway shall be closer than 60 feet to a roadway intersection as measured from the driveway edge line to the intersection of the roadway curb lines extended.*

The proposed driveway will be located 180 feet north of the G Street intersection and 229 feet south of the H Street intersection thereby meeting the minimum 60 foot spacing criteria.

- *All driveway entrances shall be constructed of poured concrete in accordance with the DDOT Standard Specifications for Highways and Structures.*

The proposed driveway will be constructed in accordance with DDOT Standard Specifications for Highways and Structures.

- *Driveway paving materials shall continue the paving color and texture of the adjoining sidewalk across the driveway as an indication to drivers that they are crossing a pedestrian pathway.*

The driveway will be constructed to visually indicate that the pedestrian path continues across the driveway, indicating to drivers that they are crossing a pedestrian pathway.

- *A driveway or parking pad shall be constructed in such a manner so that the parking of a motor vehicle thereon shall not cause any portion of the vehicle to intrude in part or whole over any portion of the public space.*

As shown on Figures 9A and 9B, trucks 24-feet or smaller that are stopped in the loading berth will not extend into public space.

- *When changes occur at a property due to redevelopment and when the proposed principal use for the property will be different from that prior to the redevelopment, all existing driveways shall be restored with new curb and gutter, tree space and sidewalk to current DDOT standards. Any existing attached curb cut proposed for the new use shall be applied for as a new curb cut and driveway at the DDOT public space permit office.*

A new public space permit for the proposed driveway will be sought from DDOT.

PEDESTRIAN COUNTS

Pedestrian counts were conducted along 21st Street and on the University Yard on October 5, 2011 from 10:30 AM to 4:00 PM. The pedestrian counts are summarized on Figures 10A and 10B. As shown on Figure 10A, the highest volume of pedestrians occurred from 11:45 AM to 12:45 PM. During that time, 575 pedestrians entered or exited the Yard from H Street where the existing curb cut would be relocated. During that same time period, 480 pedestrians were counted on the 21st Street sidewalk in the vicinity of the proposed curb cut. Peak hour pedestrian volumes at other locations on the Yard also are shown on Figure 10A.

Upon examination of the count data, it was evident that the pedestrian volumes in the University Yard remained relatively consistent throughout the afternoon. By contrast, the pedestrian volumes on 21st Street decreased after the peak hour. Figure 10B shows the pedestrian volumes during the secondary peak (1:15 PM to 2:15 PM). As shown, the volume of pedestrians entering and exiting the Yard via H Street remained high with 531 pedestrians per hour. During that same time period, the number of pedestrians on 21st Street in the vicinity of the proposed curb cut decreased to 278 pedestrians per hour – nearly half of the volume of pedestrians in the Yard.

MASSING STUDY

In order to determine the effect of relocating the loading functions to the Yard side of the building, Hartman-Cox Architects conducted a massing study of the two options. As shown on Figure 11, relocation of the loading berth from the 21st Street side to the Yard side would impact the exterior façade of the building due to the back of house operations being shifted from the Yard side to the 21st Street side to accommodate the loading berth on the Yard side. Initial conversations with Office of Planning's Historic Preservation Office suggested that such a shift would have a negative impact on the adjacent Corcoran Hall – a registered historic landmark. Additionally, the shift would create functional disadvantages on the upper gallery levels and the below-grade levels.

CONCLUSIONS AND RECOMMENDATIONS

As detailed herein, the Museum presents unique loading needs that require an on-site loading berth. Square 102 contains no existing alley network, and accordingly two options for truck access to the on-site loading berth were considered; specifically, use of the existing curb cut on H Street and use of the proposed curb cut on 21st Street.

The feasibility of using the existing curb cut on H Street to the University Yard was evaluated and was determined to be infeasible for the following reasons:

- The University Yard is used for a number of different functions, including a major pedestrian walkway, a special events location, and an active and passive recreational area. Introduction of trucks on the Yard potentially could introduce significant safety risks.
- The University Yard is a key accessible route for Corcoran Hall, Lisner Hall, and Lerner Hall.
- The volume of pedestrians entering and existing the Yard via H Street at the location trucks would enter the Yard is considerably higher than the volume of pedestrians on 21st Street, and remains at a high level over the entire day while the volume of pedestrians on 21st Street decreases significantly.
- A number of mature trees designated are present on the Yard, several of which are likely to be damaged by truck traffic through the Yard.
- Both H Street and 21st Street are collector roadways. Although 21st Street carries a slightly higher ADT, 21st Street has two travel lanes during the day; whereas, H Street has only one lane in each direction. Therefore, based on functional class or volumes, one street is not preferential over the other.
- The shifting of the loading berth from 21st Street to the Yard would have an undesirable impact on the design of the building.

The proposed curb cut on 21st Street will ensure that priceless and irreplaceable artifacts will be protected during the loading and unloading process. In order to minimize the impact of the loading operations on pedestrian and vehicular traffic, the following measures will be implemented:

- On-site staff will be responsible for scheduling deliveries to ensure that no overlap of deliveries will occur.
- The loading berth has been designed to ensure that the delivery vehicles will not protrude onto public space during the loading and unloading processes.

- During the infrequent occasions when a tractor trailer truck will be required to make deliveries (every one to three years), University staff will apply for a permit to establish a temporary no parking zone during non-peak hours on 21st Street along the Museum frontage to accommodate the vehicle or will direct the delivery drivers to use the planned designated “No Parking” area in front of the building on 21st Street.
- The conservation and resource center in Virginia will be utilized (to the extent possible) as a staging area in order to consolidate the number of deliveries to the Museum and in order to limit the number of tractor trailers that will be required to deliver to the Museum.

Based on the above, the proposed curb cut on 21st Street was determined to be the only viable option for truck access to the Museum’s proposed loading dock.

We hope that this memorandum provides you with sufficient information regarding the GW Museum’s proposed curb cut on 21st Street. Please do not hesitate to contact us at (724) 933-9010, jlmlanovich@mjwells.com, or bmtucker@mjwells.com with any questions you may have regarding this memorandum.

FIGURES



Figure 1
Site Location Map

GW Museum
Washington, DC



WELLS + ASSOCIATES

W:\PROJECTS\5183 GW MUSEUM PROJECT\GRAPHICS\TRUCK TURNING.DWG

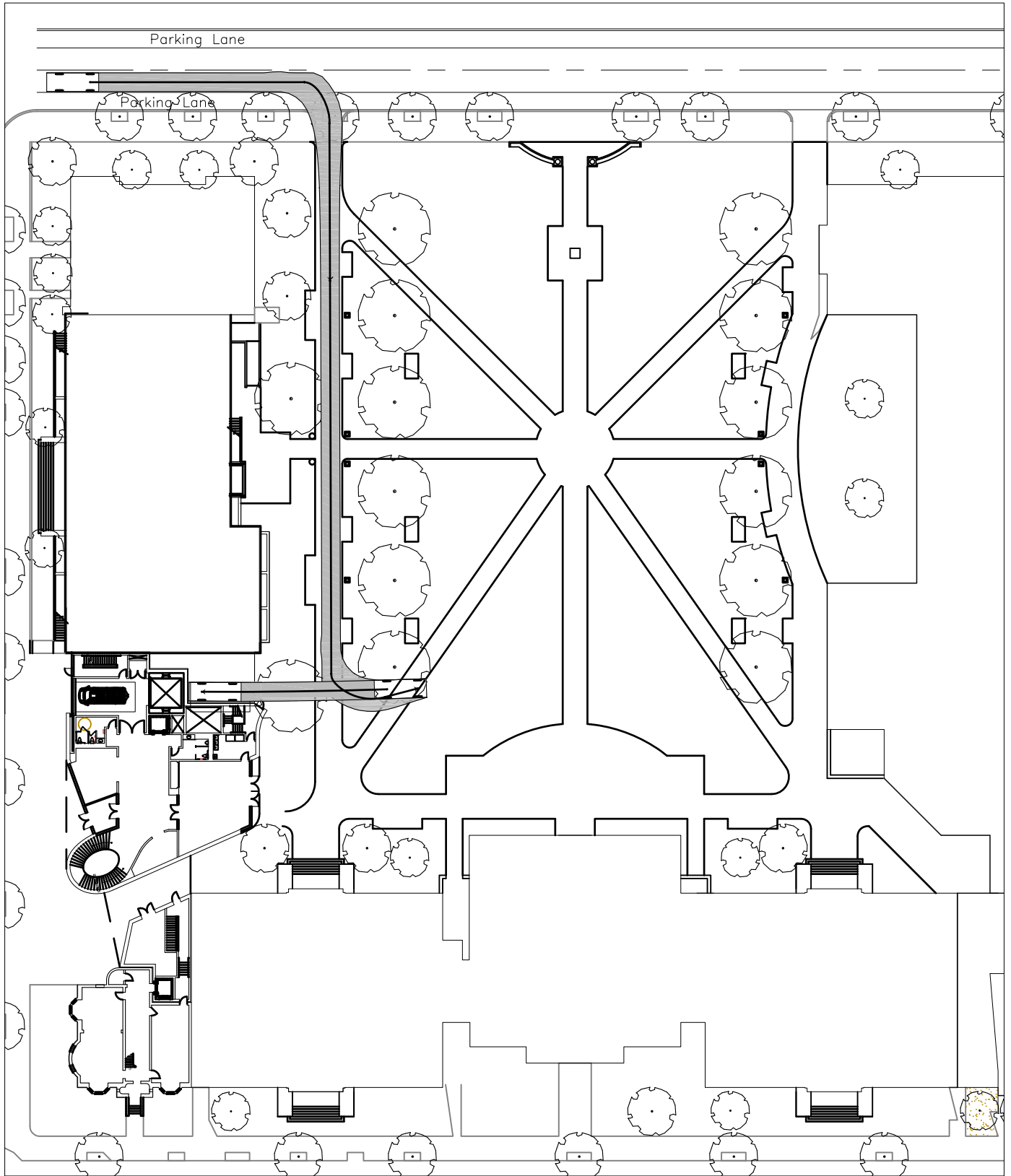


Figure 2A
Truck Turning Diagram—Entering
Option: Relocated Curb Cut on H Street



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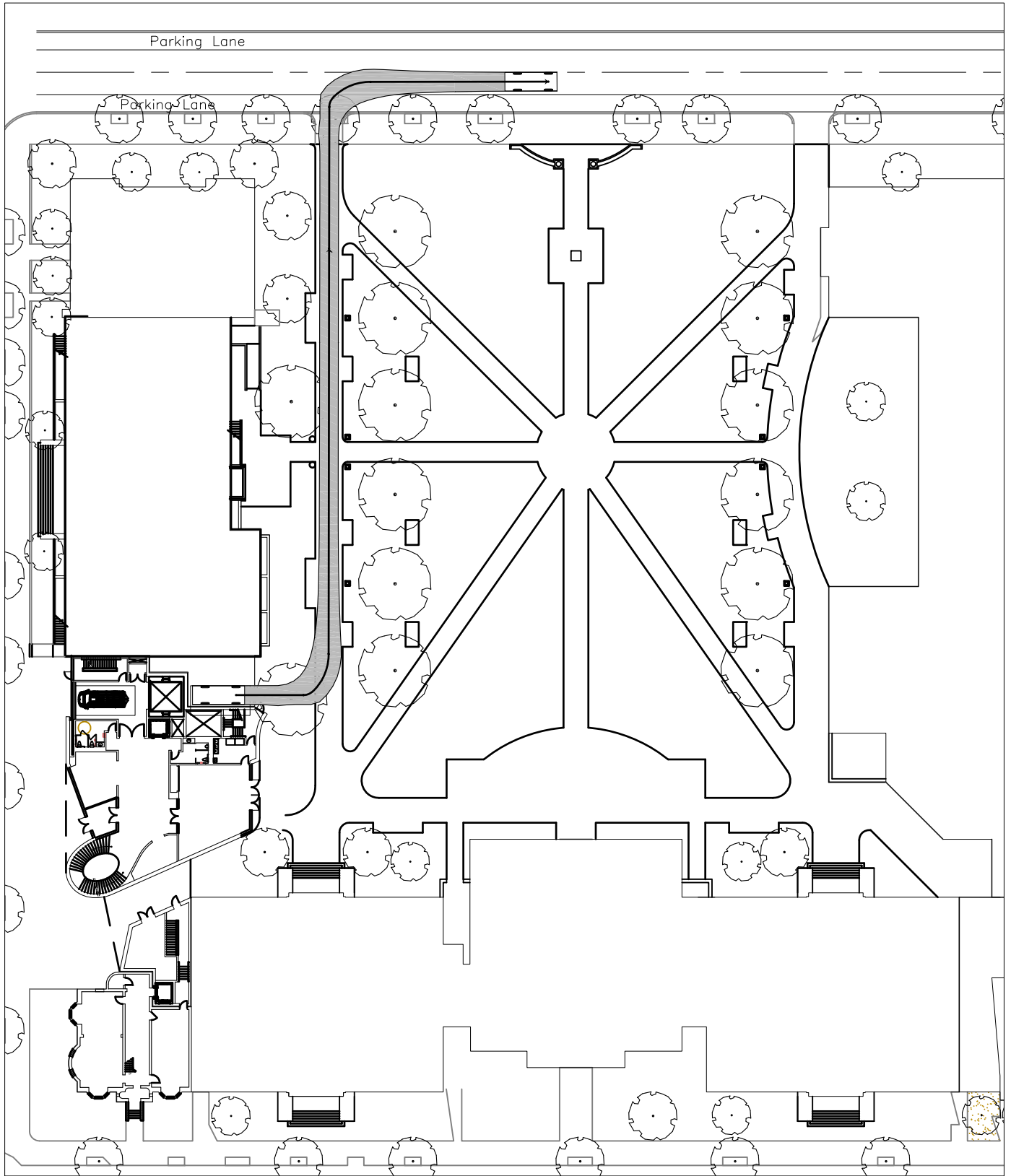
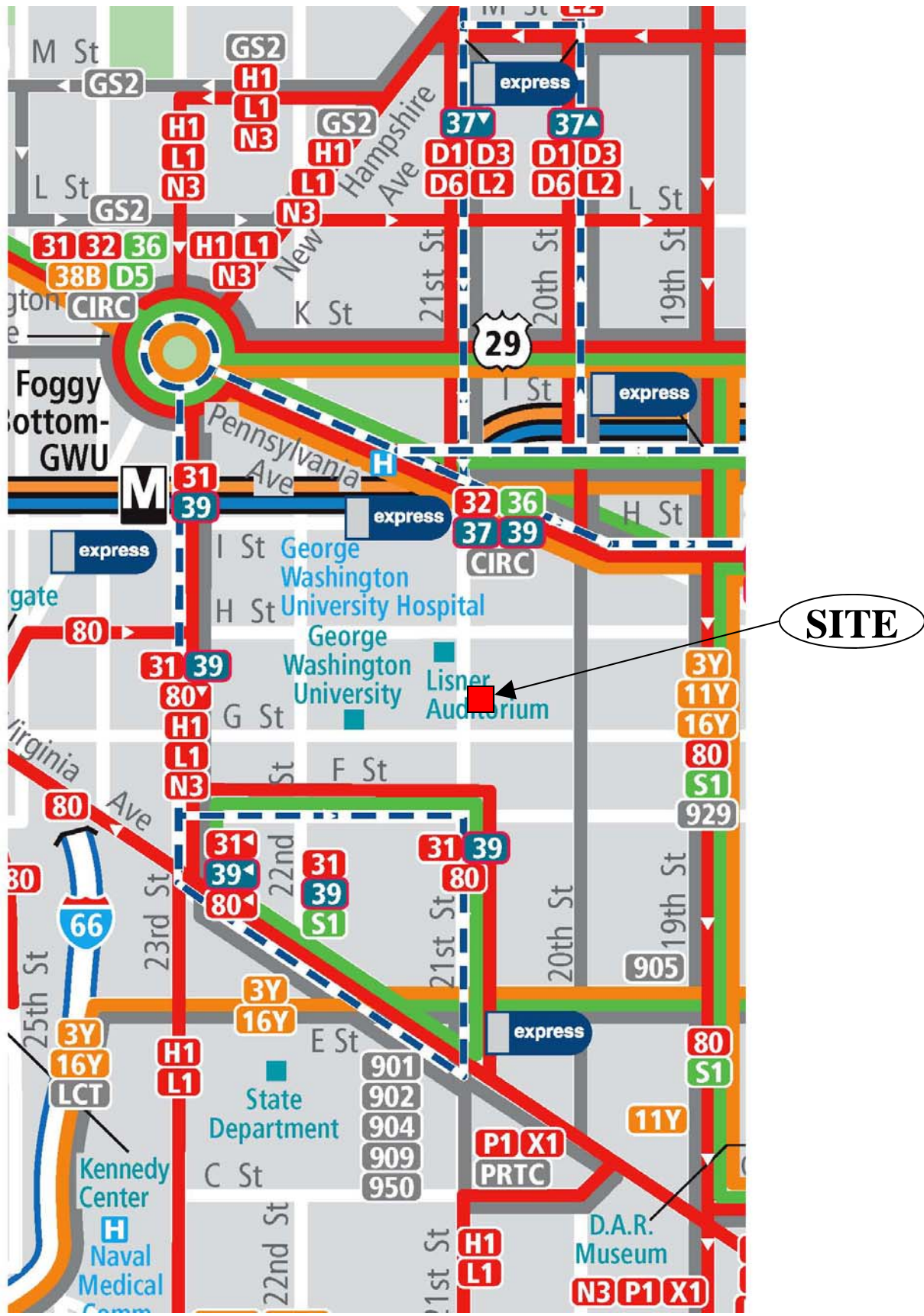


Figure 2B
Truck Turning Diagram—Exiting
Option: Relocated Curb Cut on H Street





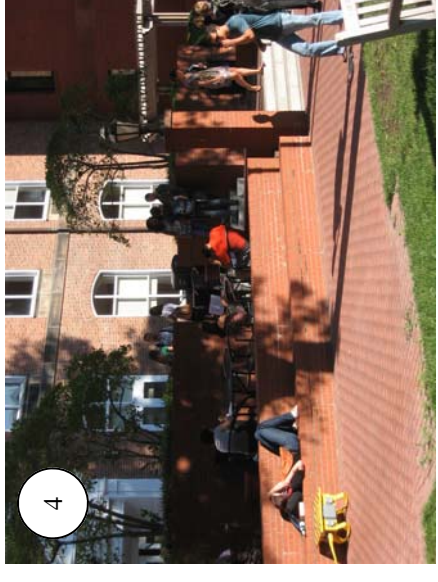
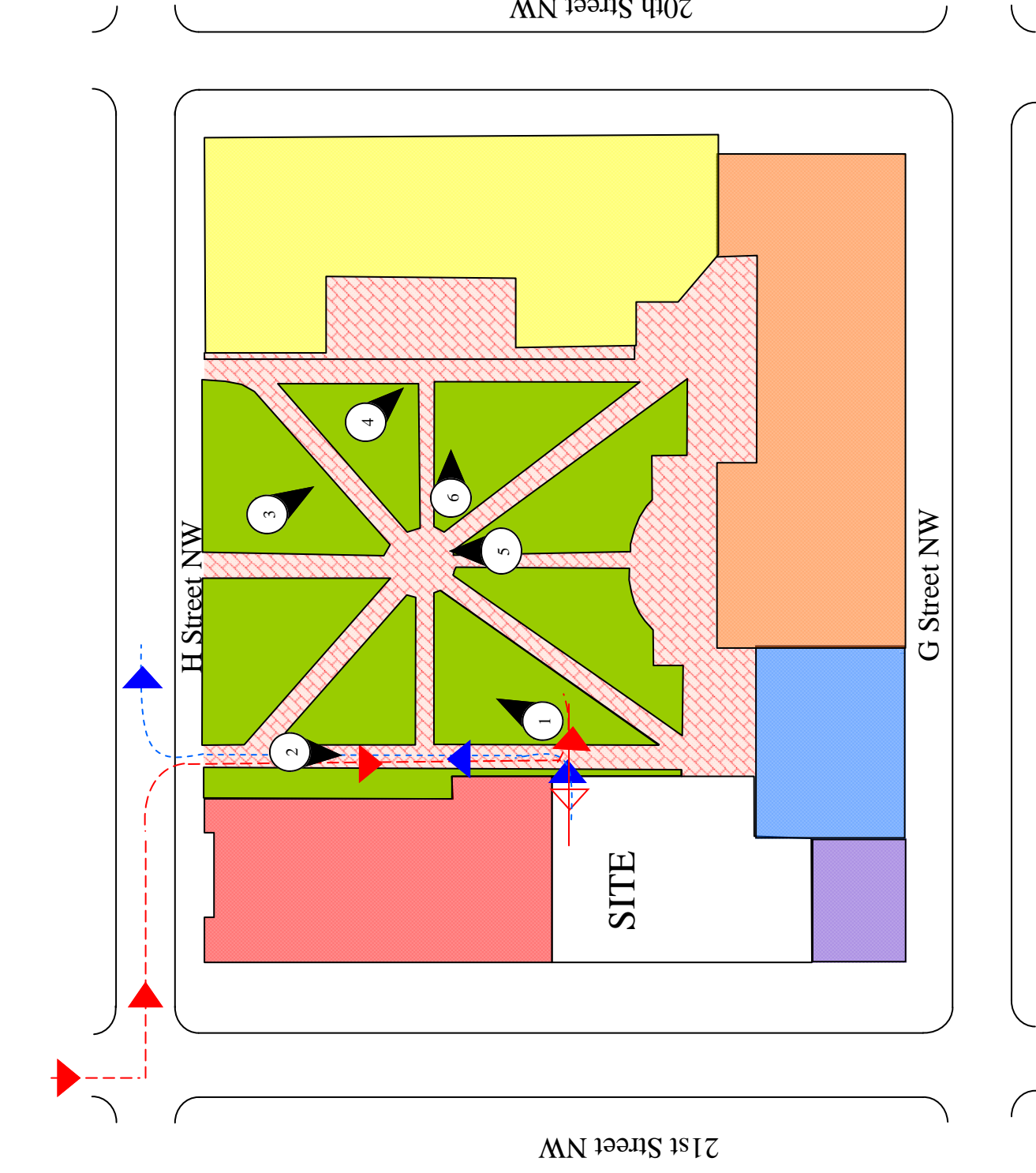
Source:
 Maryland and
 Washington D.C.
 Metro System
 Route Map

Figure 3
 Bus Route Map



GW Museum
 Washington, DC





- ▲ Truck Exiting Site- Forward
- ▲ Truck Approaching Site- Forward
- ▲ Truck Exiting Site- Backward
- ▲ Truck Approaching Site- Backward

○ x Picture Number, Black arrow indicates direction of picture



Figure 4
Truck Routing Diagram
Option: Relocated Curb Cut on H Street

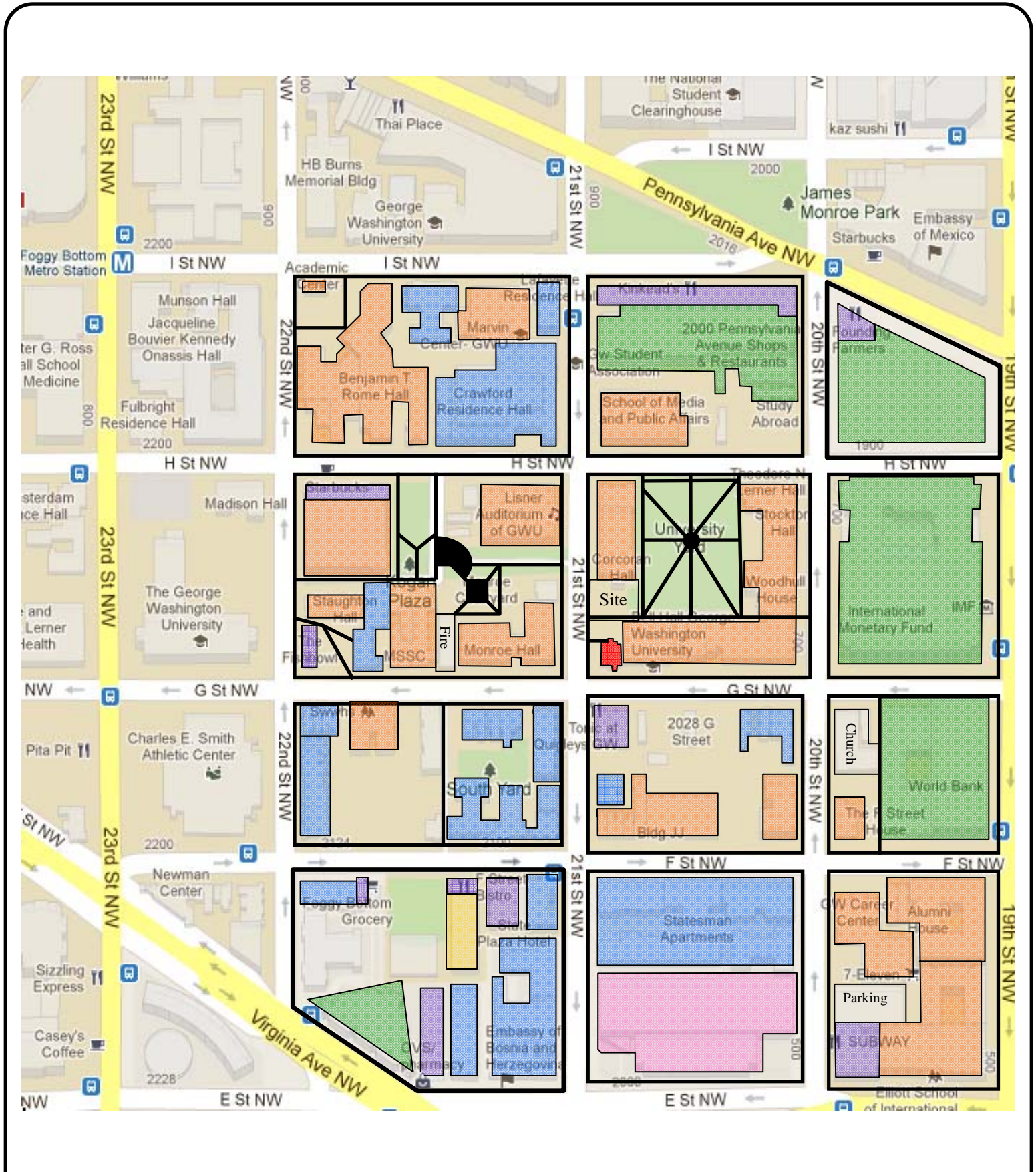


Figure 5
Map of Surrounding Land Uses

- Office
- Academic Use
- Retail/Restaurant
- Apartment/Townhouses
- Red Cross
- Hotel
- Sidewalk
- B Bus Stop
- ▲ North
- M Metro Stop

GW Museum
Washington, DC

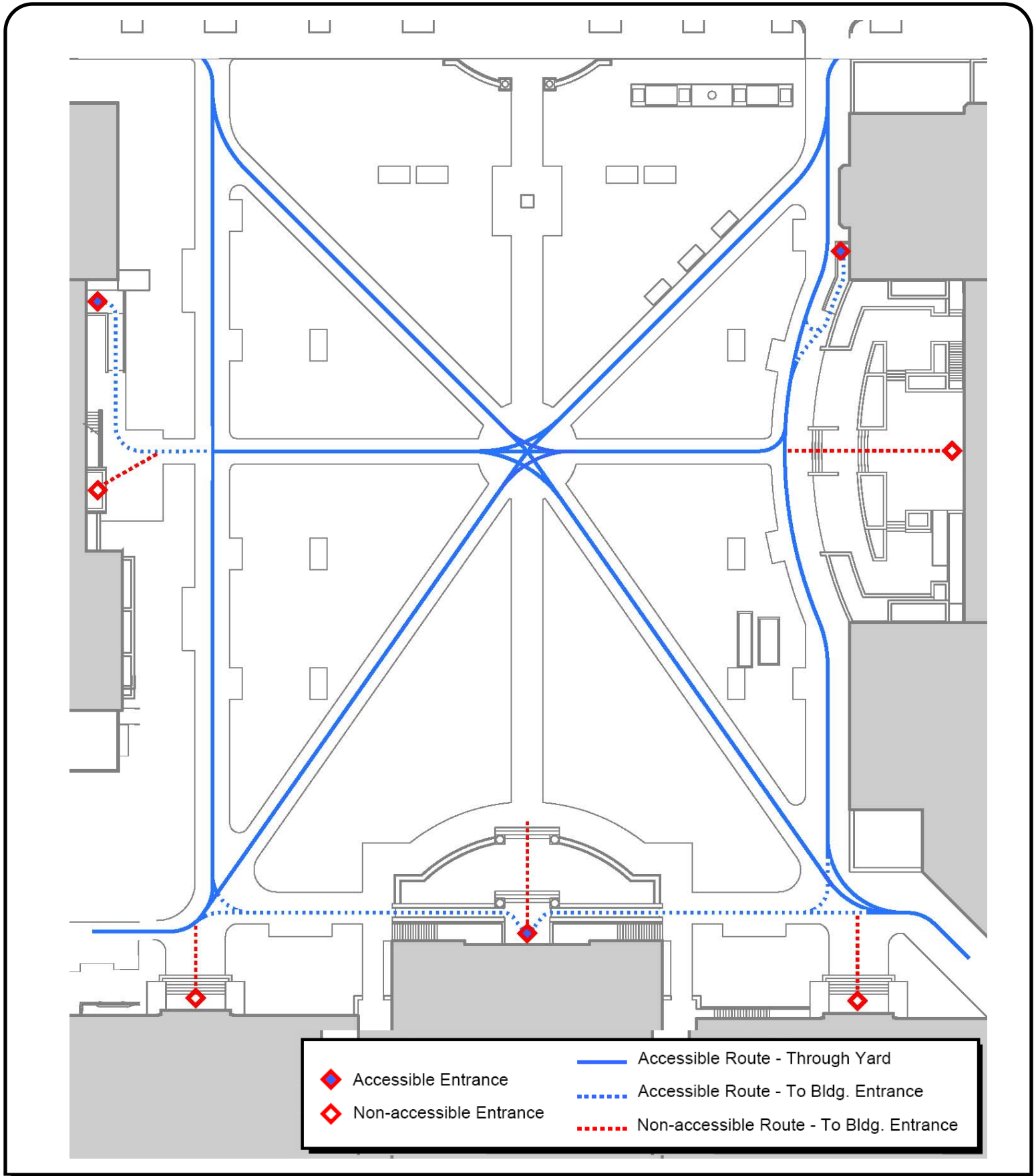


Figure 6
Entrance Locations and Accessible Routes



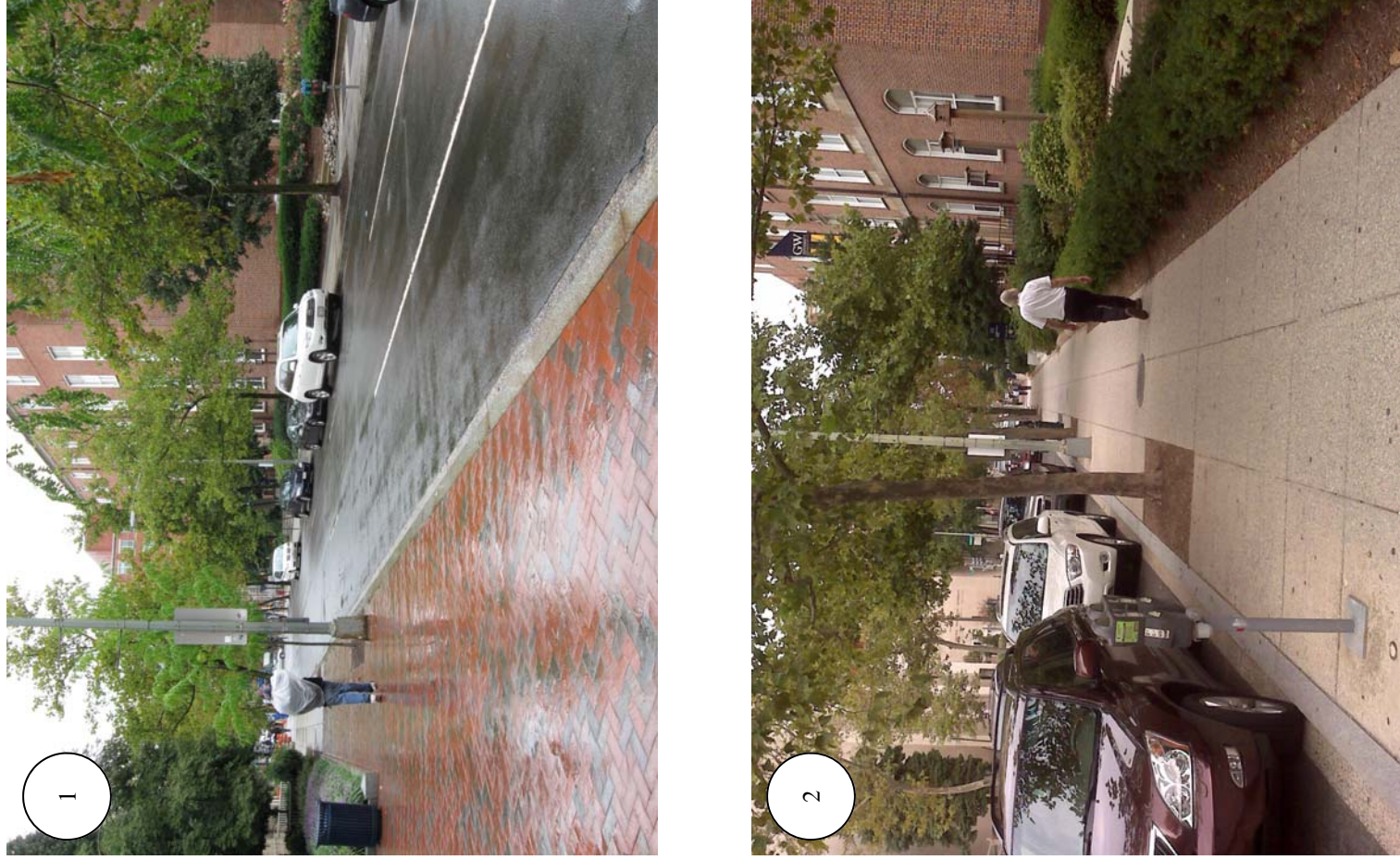
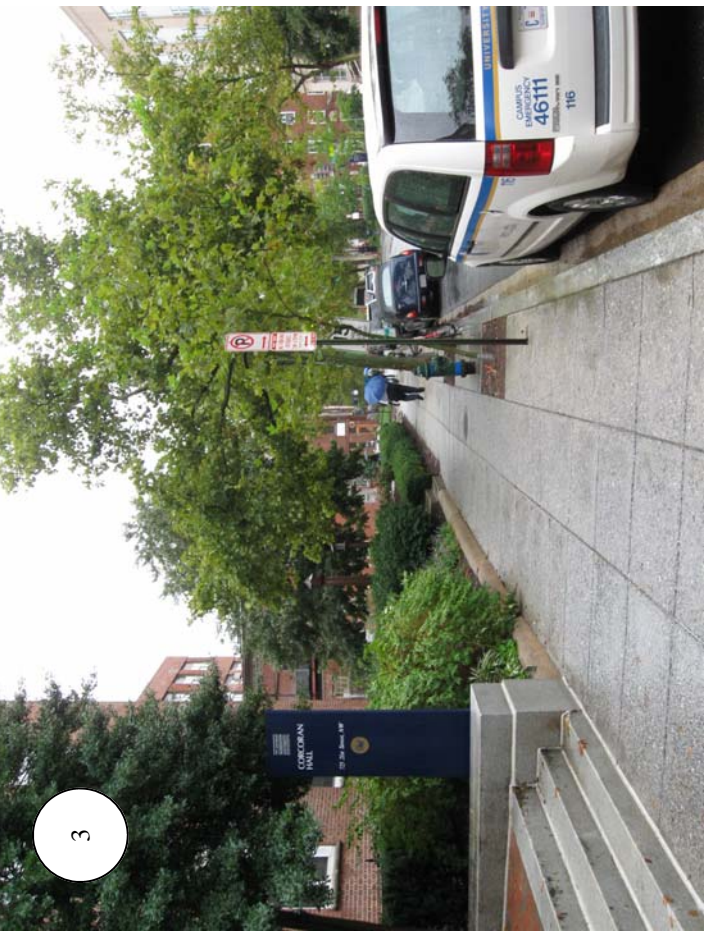
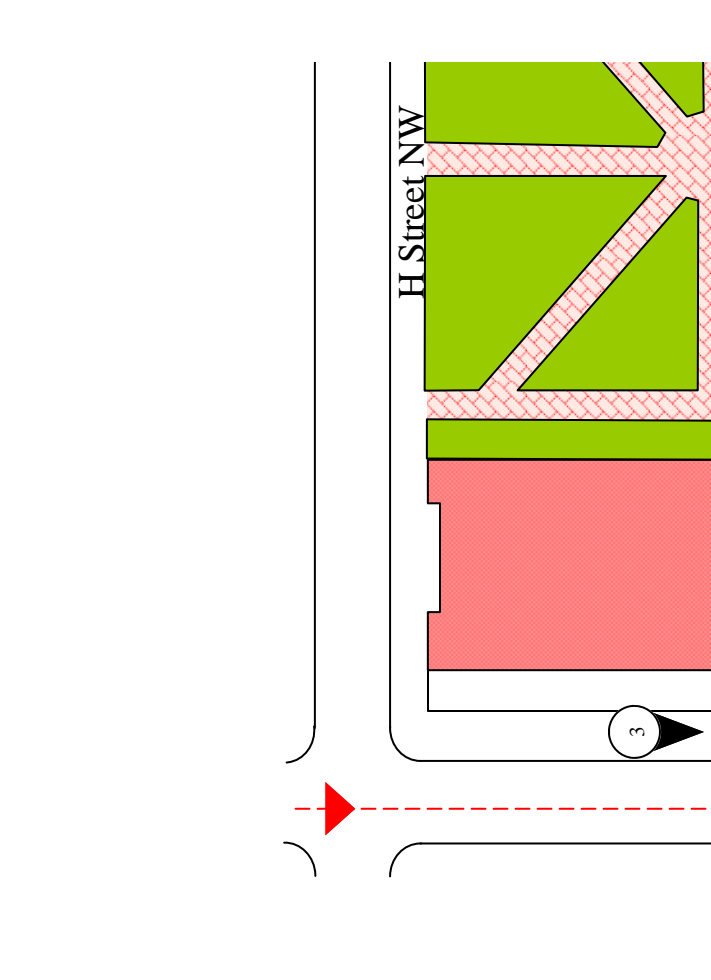
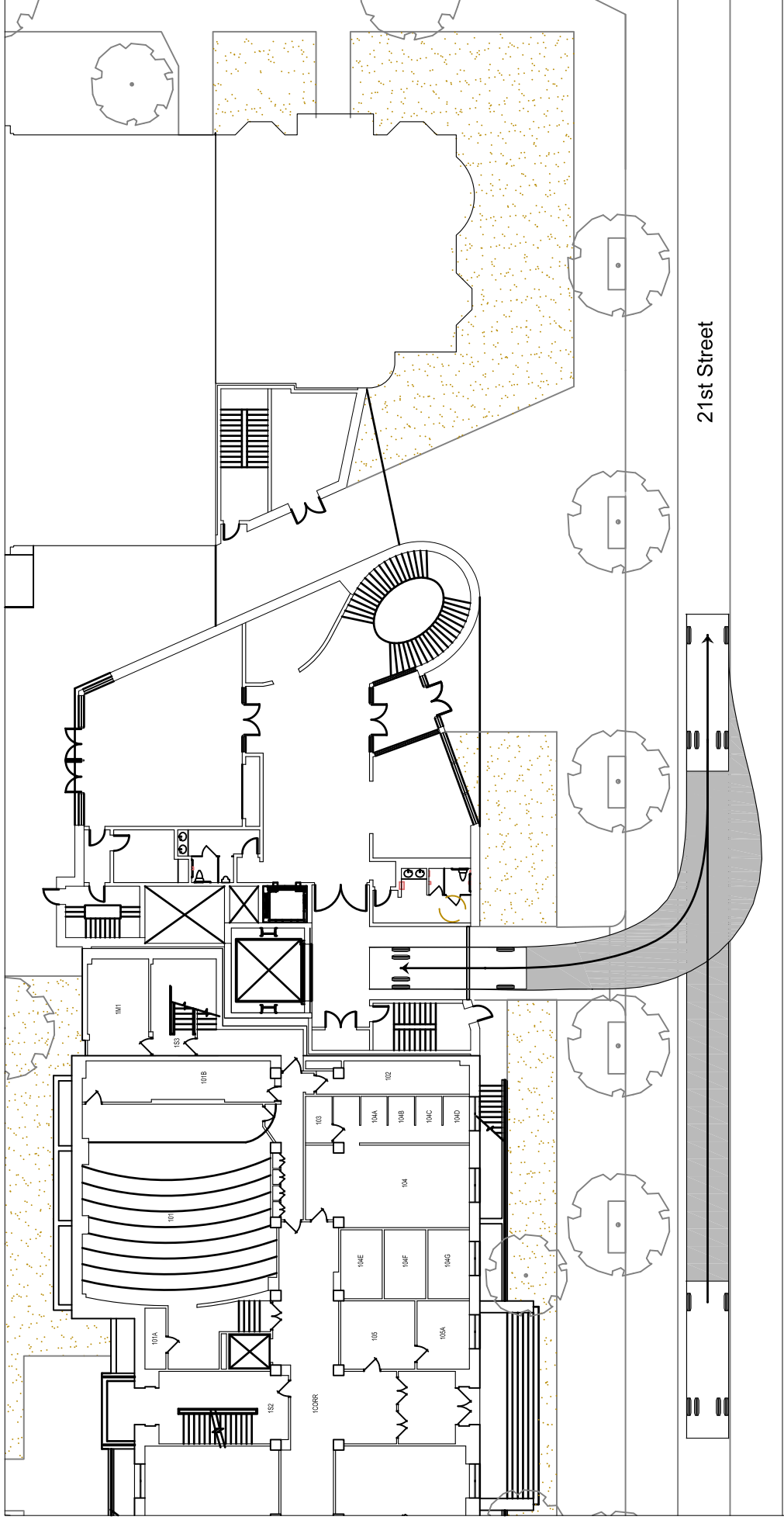


Figure 7
Truck Routing Diagram
Option: Proposed Curb Cut on 21st Street

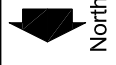
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- Truck Approaching Site- Forward
- Truck Exiting Site- Backward
- Truck Approaching Site- Backward
- Picture Number, Black arrow indicates direction of picture

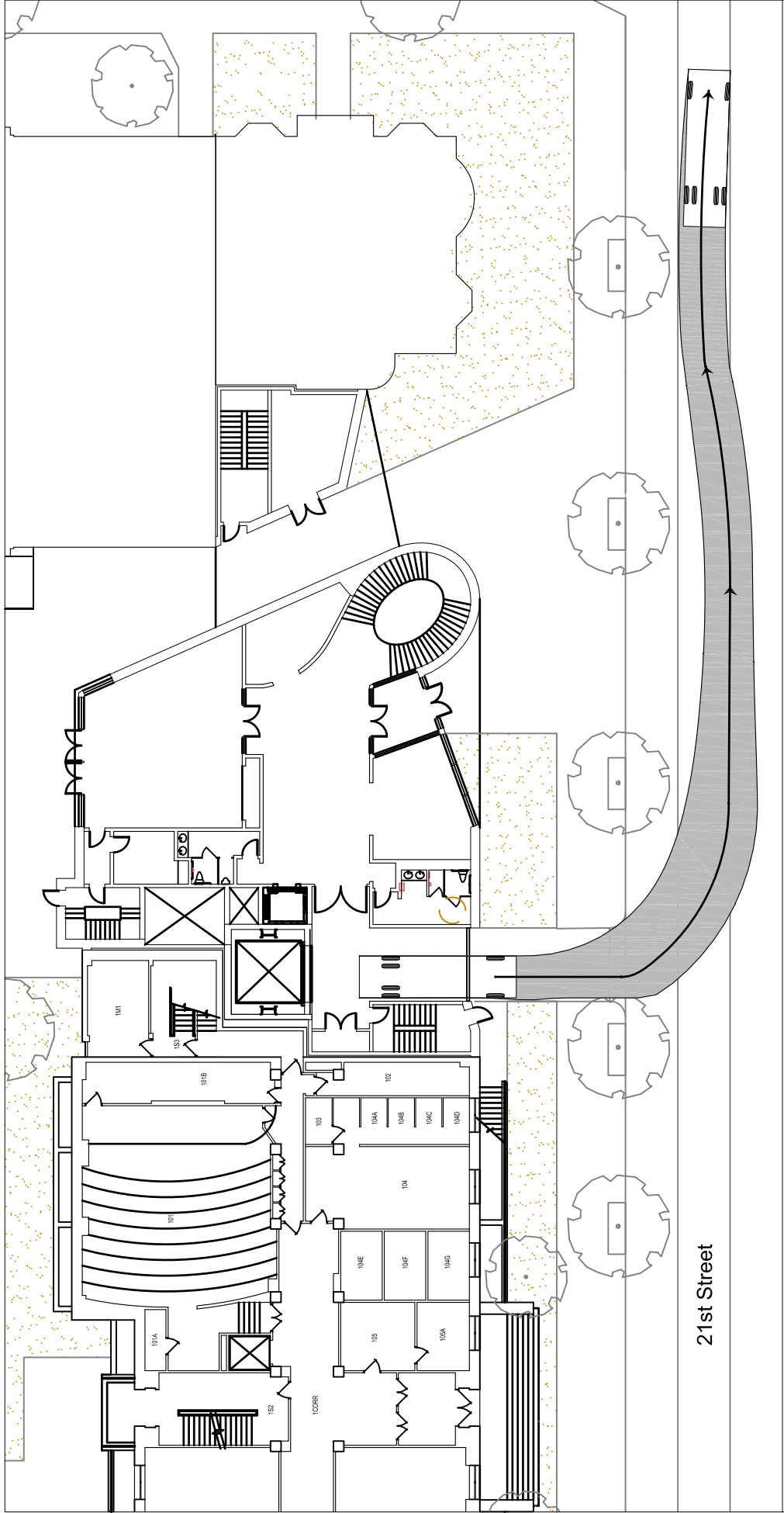




Note: Maximum 24' truck will be permitted to use the curb cut; however, Autoturn templates are available for 21' trucks and 30' trucks; therefore the diagram shows a 30' single unit truck .

Figure 8A
30' Single Unit Truck Entering Site





Note: Maximum 24' truck will be permitted to use the curb cut; however, Autoturn templates are available for 21' trucks and 30' trucks; therefore the diagram shows a 30' single unit truck .

Figure 8B
30' Single Unit Truck Exiting Site



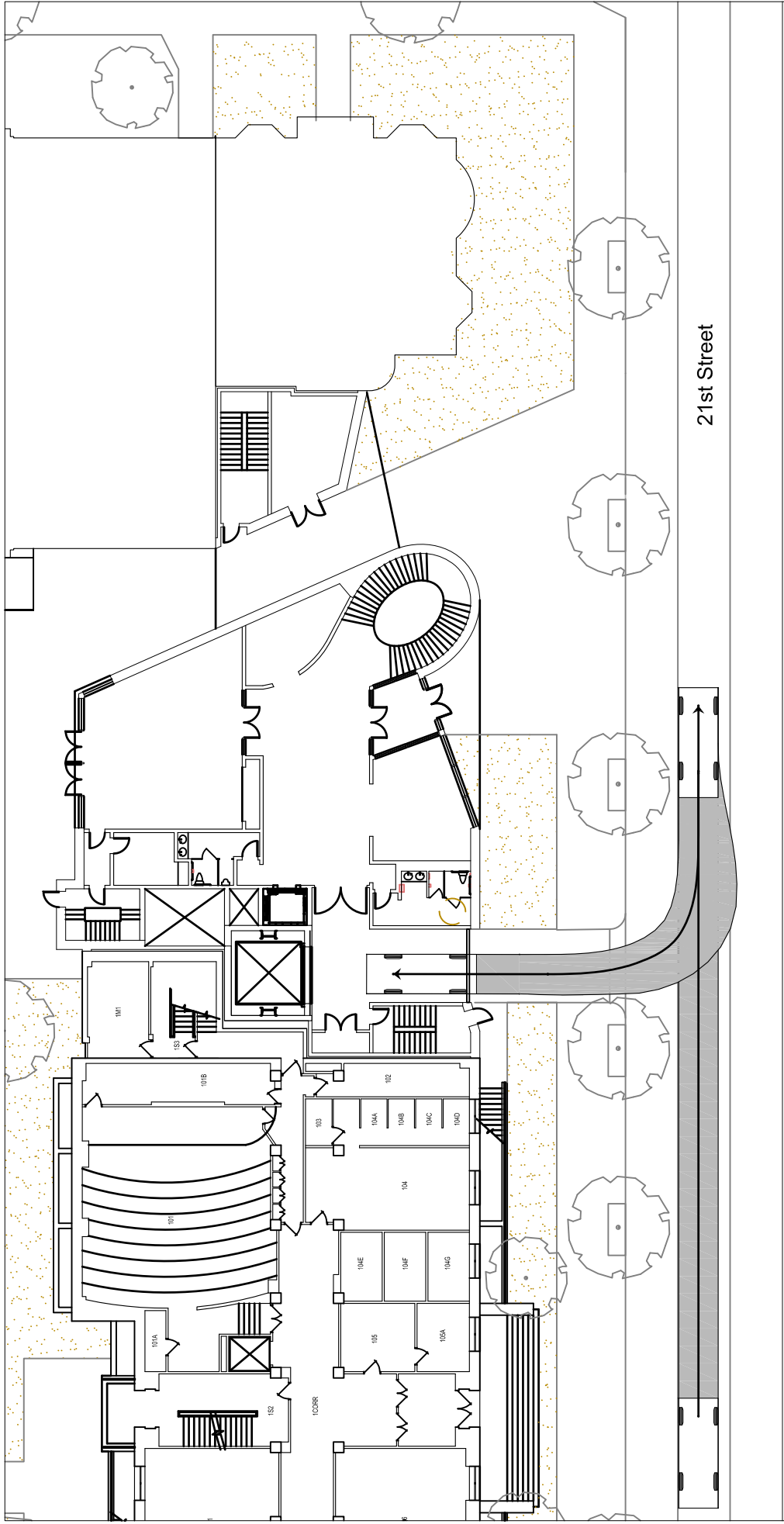
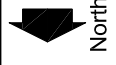


Figure 8C
21' Truck Entering Site



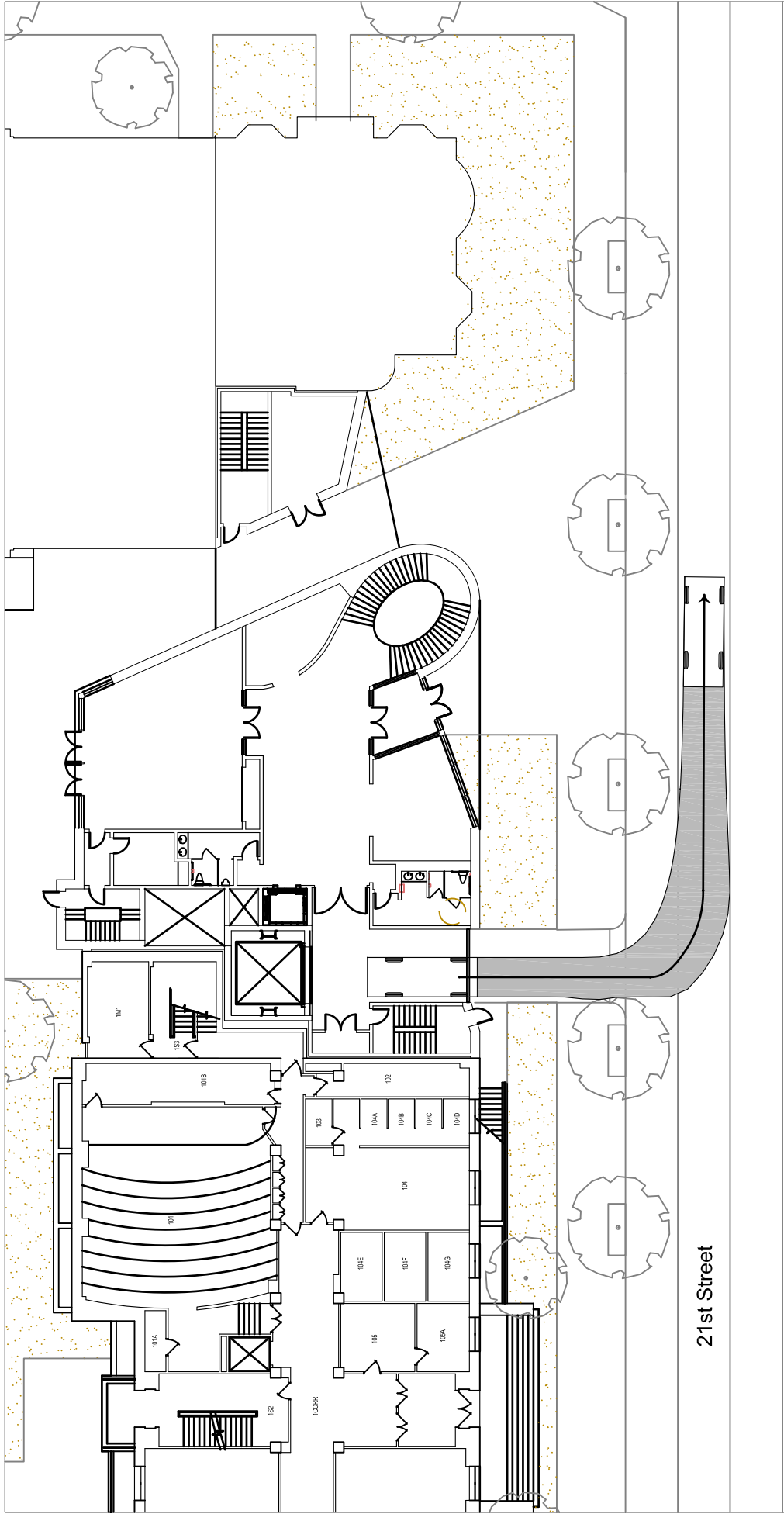
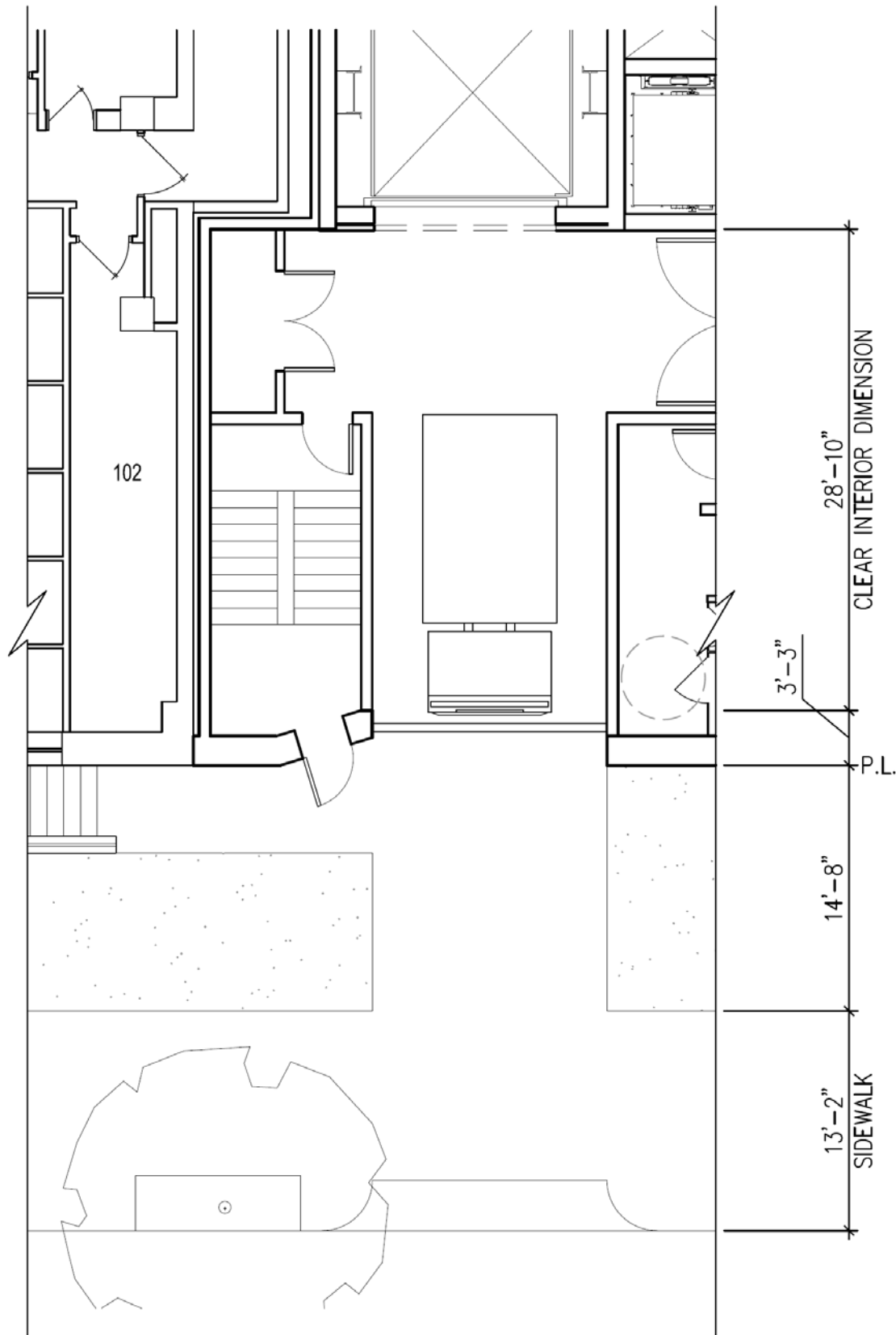


Figure 8D
21' Truck Exiting Site

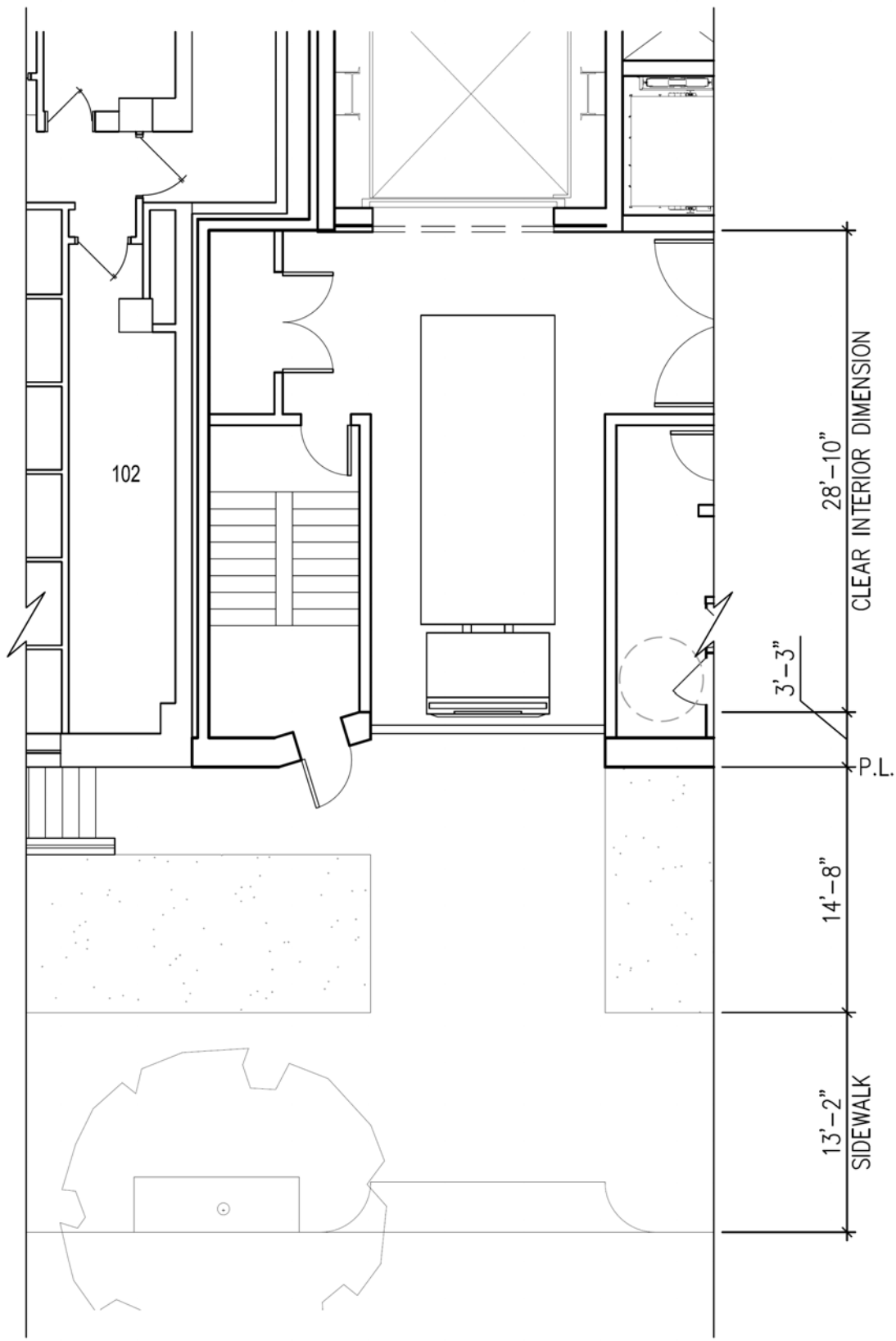




NOT TO SCALE

Figure 9A
Detail Drawing of Loading Area (18-foot truck)





NOT TO SCALE

Figure 9B
Detail Drawing of Loading Area (24-foot truck)



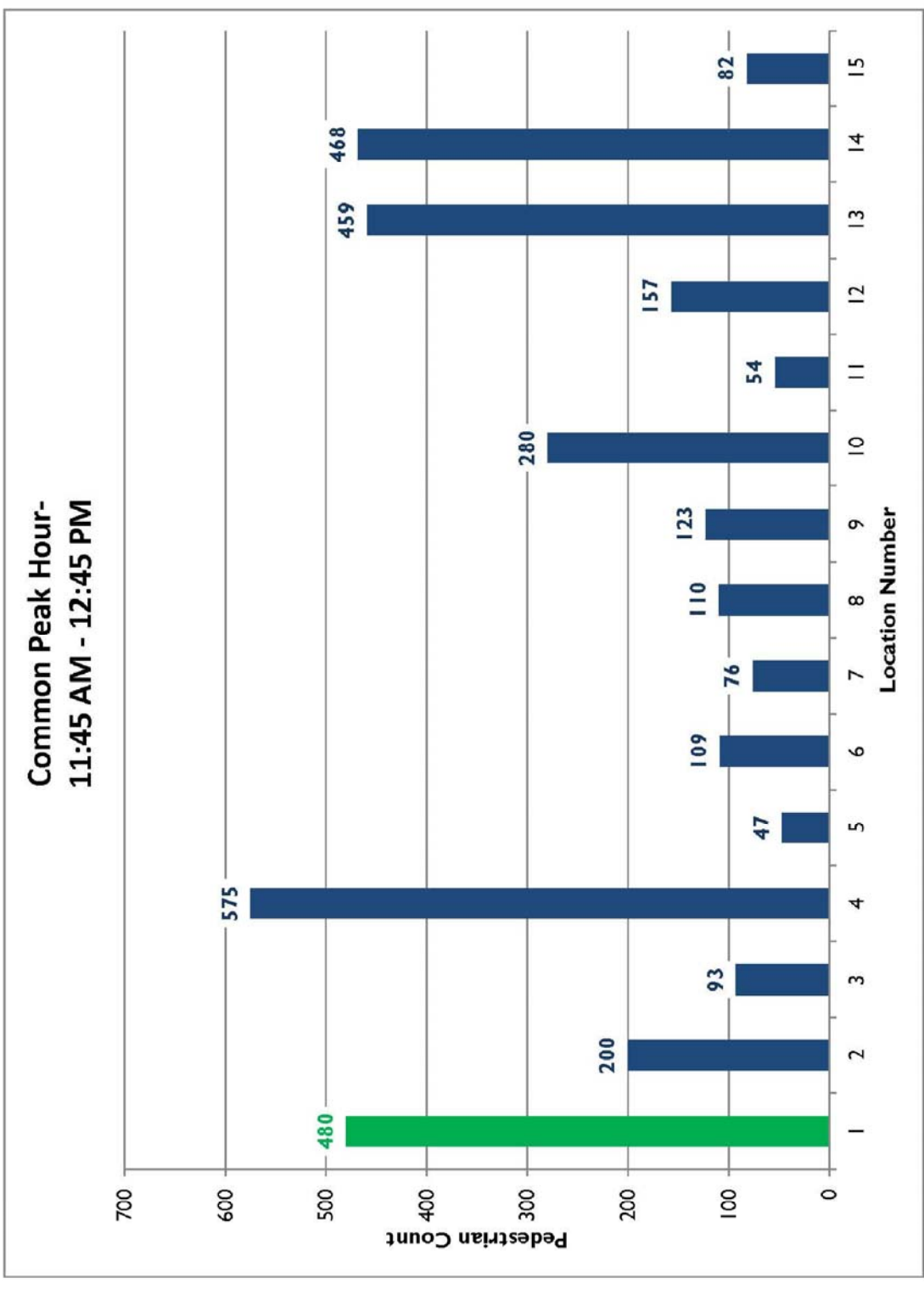
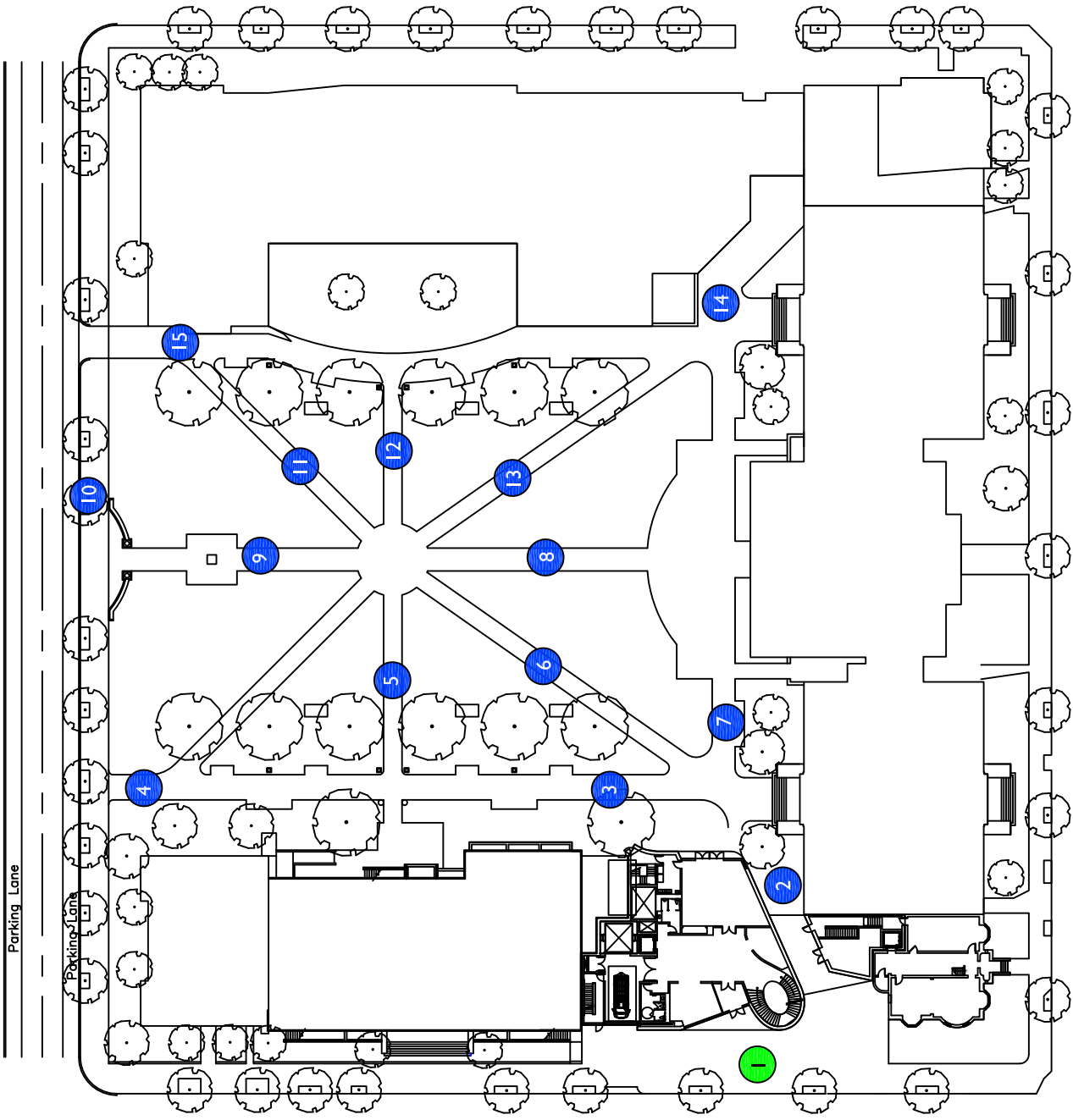
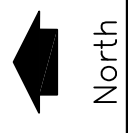


Figure 10A
Pedestrian Counts – Common Peak Hour (11:45 AM – 12:45 PM)



W:\PROJECTS\5183 GW MUSEUM PROJECT\GRAPHICS\REVISED LOADING MEMO\FIGURE 10 A B PED COUNTS.DWG

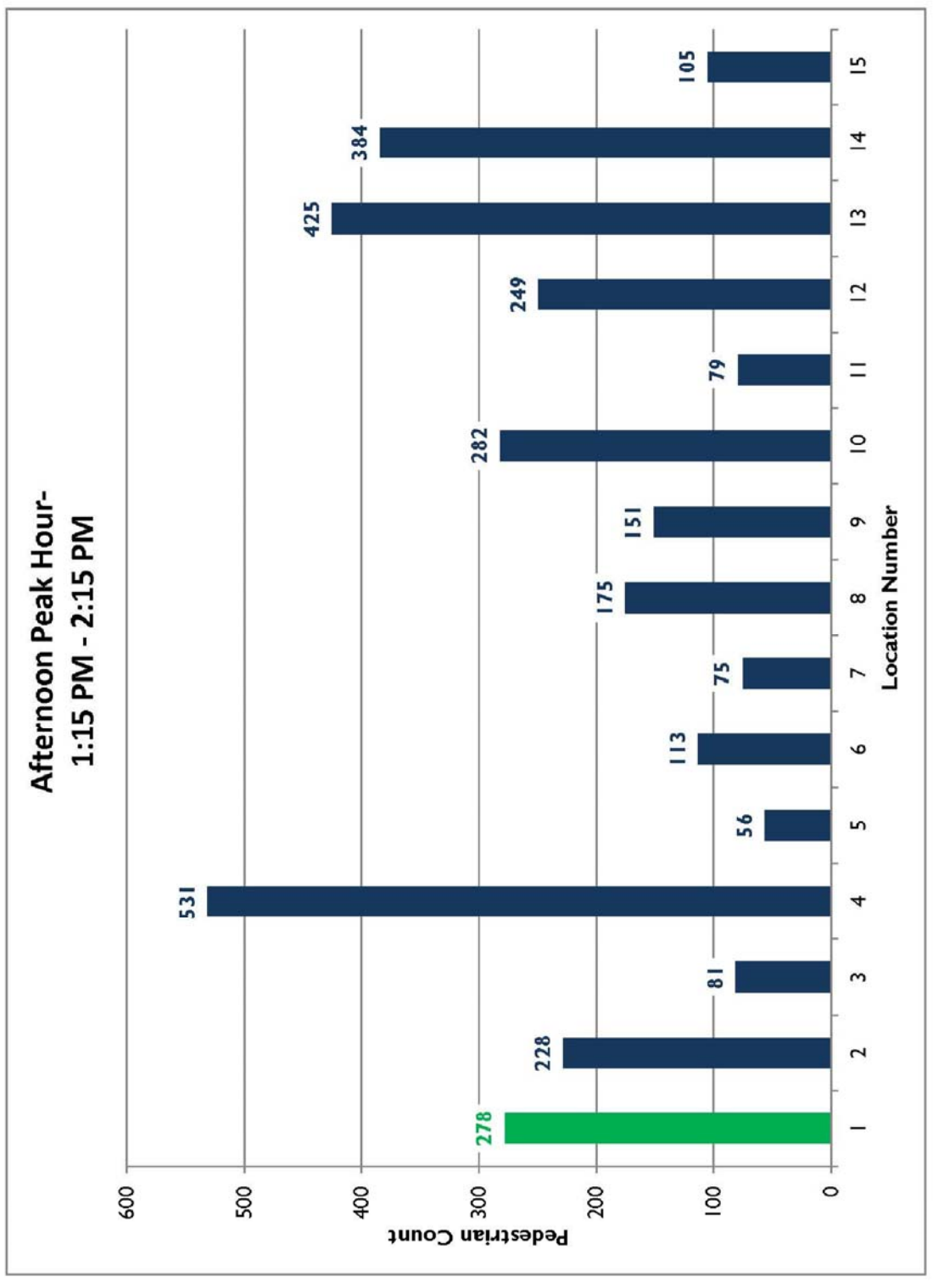
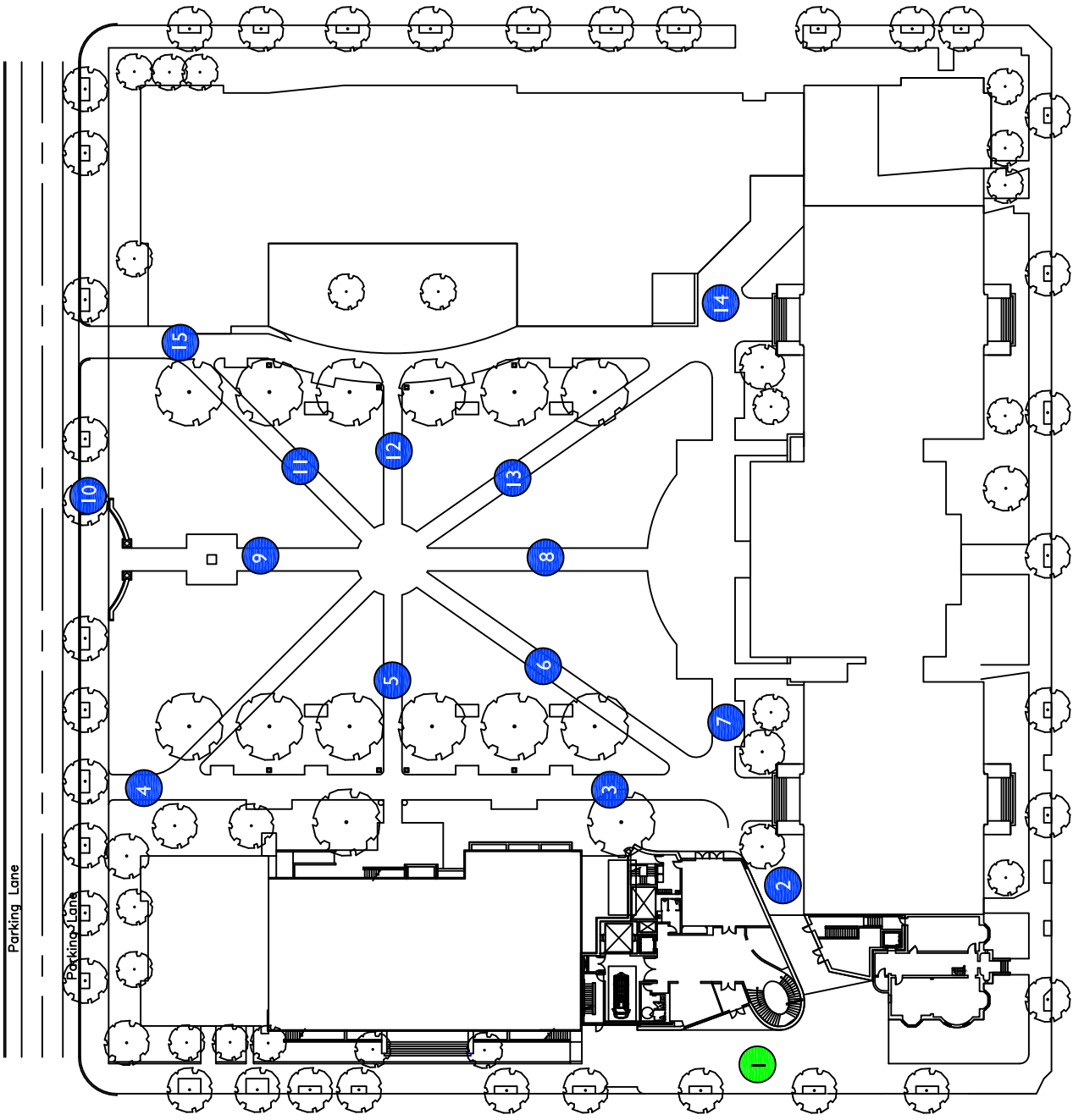
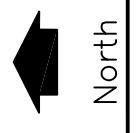


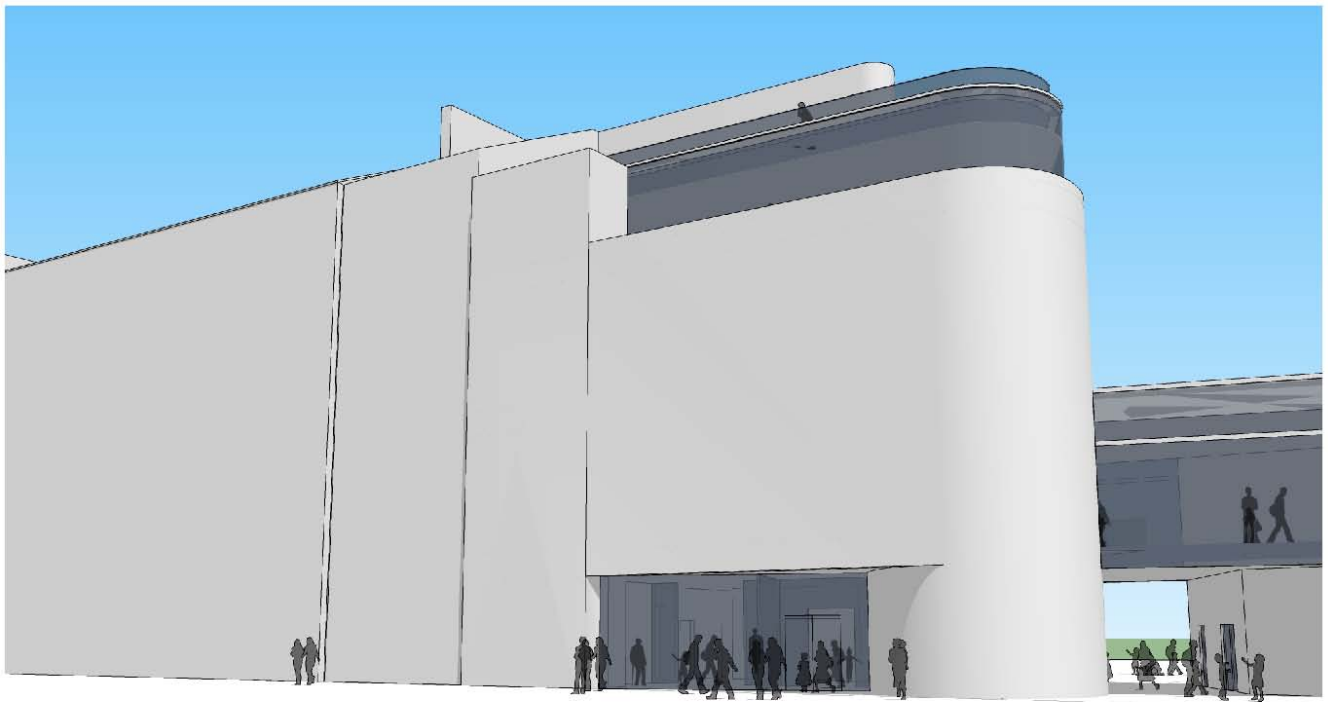
Figure 10B
Pedestrian Counts – Afternoon Peak Hour (1:15 PM – 2:15 PM)



W:\PROJECTS\5183 GW MUSEUM PROJECT\GRAPHICS\REVISED LOADING MEMO\FIGURE 10 A B PED COUNTS.DWG



21st Street Massing with Loading Berth Accessed from Street



21st Street Massing with Loading Berth Accessed from Yard

Figure 11
Massing Study
Comparing Loading Access via 21st Street and via the University Yard



ATTACHMENT I

Arborist Report



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Arborist Report

The George Washington University Museum Washington D.C.

*Assessment of Impact to Trees From
Proposed Service Road Alignment*

4 October 2011

Prepared for:

OCULUS

Prepared by:

Davey Resource Group

Cary Hulse

ISA #PD1080A

Introduction

The Davey Resource Group has been asked to provide an assessment of expected tree impacts from the proposed service road construction through the University Yard from H Street to the site of the proposed museum facility in Washington D.C.

Provided below is general information, and a detailed outline of the impacts to the tree community including trees that must be removed and a summary of treatments and measures required to adequately protect the remaining trees.

The attached exhibit shows expected work limits of the project and the adjacent trees, including tree numbers and associated Critical Root Zonesⁱ.

Critical Root Zone (CRZ) and Tree Protection Area (TPA)

The CRZ of a tree to be protected should be determined prior to any activity around the tree. The area should be designated as a Tree Protection Areaⁱⁱ (TPA) and protected to the greatest extent possible. Equipment access, staging, stockpiling, construction access, grading, excavation, grubbing, compaction and all other disturbance should remain outside this area. If any activity must take place within this area, tree protection measures will be needed to protect the tree from unnecessary damage and, depending on the degree of impact, stress mitigation measures must be taken to aid the tree's survival. Serious impacts to the CRZ area (over 30% impact, or impact very close to the trunk where the tree's large roots and structure are damaged) would likely warrant removal of the tree.

The CRZ is defined as a circle with a radius equal to 1.5 feet per inch of tree diameter at breast height (DBH, measured at 4.5 feet above grade).

The degree of impact proposed for each individual tree is determined with this method based on the established limits of work or limits of disturbance for the project.ⁱⁱⁱ

Discussion

The proposed limits of disturbance (LOD) for the project will be in close proximity to several trees. Notably, trees 924, 929, 935 and 941 and other smaller trees are either completely within the LOD or are so close that the tree's structure will be compromised and removal will be required. Refer to the attached exhibit for tree numbers and a graphic depiction of the trees' CRZs.

In addition to the trees that must be removed, several trees will be significantly impacted, but may be retained. All the trees on the east side of the proposed road can remain, but will be significantly impacted. These are trees 930, 931, 932, 933 and 934. Other smaller trees will also be impacted to a lesser degree.

Most severely impacted will be tree 934, with over 30% of its CRZ impacted. This tree will require a high degree of stress reduction measures and long term care to ensure its survival.

To mitigate the impacts to these trees, various tree protection and stress reduction measures will be required. Examples of these measures are provided below.

Tree Protection Measures:

- Tree Protection Fence – typically a welded wire or chain link fence installed specifically to prevent construction access to TPA's
- Signage – tree protection areas must be posted with signs alerting the contractors to the limitations of the areas.
- Clearance Pruning – pruning tree limbs for specific clearance from construction activities.
- Special Protection Measures – several special protection measures are available for specific situations. These may include Root Protection Matting, Root Aeration Matting, Temporary Trunk Protection, “By Hand” Excavation, and others.

Stress Reduction Measures:

- Root Pruning – to minimize damage to tree roots by construction excavation, roots are severed, typically at the LOD line, by specific methods that cause a clean cut. A clean cut root causes less stress to the tree and the tree can better react to it.
- Growth Regulator – trees that have lost significant portions of their root zone can benefit from a chemical growth regulator that helps the tree redistribute its resources and promotes root re-generation.
- Soil Care – fertilization, organic soil amendments and other treatments are recommended for impacted trees to improve the health of remaining roots.
- Mulch – composted, organic wood chip mulch applied to the remaining root zones of trees to be protected is required to buffer the soil from dramatic changes in soil temperature and soil moisture levels thus reducing tree stress.

Tree Inventory Table

Tree #	DBH	Common Name	Condition Rating	CRZ	Removal	Comments	Additional Notes
916	6	dogwood, Kousa	Good	9			
917	16	pear, callery	Poor	24	X		Poor Structure, cable and brace or remove codominant leaders
918	15	pear, callery	Poor	23	X		Poor Structure, cable and brace or remove codominant leaders
919	5	dogwood, Kousa	Good	8			
920	4	dogwood, Kousa	Fair	6			Mechanical Damage,
921	9	persimmon, common	Fair	14	X		Poor Root System,
922	10	magnolia, saucer	Fair	15	X		Cavity or Decay, cabling system installed
923	3	magnolia, star	Good	5	X		Memorial Tree, Memorial: Robert L. Weintraub, BS'31, MA'33, PhD'38 1912-1996
924	33	ginkgo	Poor	50	X	UFA SPECIAL TREE	Poor Structure, cable and brace or remove codominant leader; female tree; hangers
925	2	viburnum, spp.	Good	3	X		2 trees
926	4	dogwood, Kousa	Good	6			
927	5	dogwood, Kousa	Good	8			
928	2	dogwood, Kousa	Good	3			Mechanical Damage,
929	20	oak, willow	Fair	30	X	UFA SPECIAL TREE	
930	22	oak, willow	Poor	33		UFA SPECIAL TREE	Poor Structure, poor root system
931	26	oak, willow	Good	39		UFA SPECIAL TREE	
932	23	oak, willow	Good	35		UFA SPECIAL TREE	
933	25	oak, willow	Good	38		UFA SPECIAL TREE	
934	35	oak, willow	Good	53		UFA SPECIAL TREE, SERIOUS IMPACT	
935	37	ginkgo	Good	56	X	UFA SPECIAL TREE	female tree
936	7	dogwood, Kousa	Good	11			
937	7	dogwood, Kousa	Fair	11			Signs of Stress,
938	8	dogwood, Kousa	Good	12			
939	2	zelkova, Japanese	Good	3			
940	7	elm, spp.	Good	11			
941	14	elm, spp.	Poor	21	X		Poor Root System, leaning
942	4	zelkova, Japanese	Good	6			
943	8	arborvitae, eastern	Good	12			

Tree #	DBH	Common Name	Condition Rating	CRZ	Removal	Comments	Additional Notes
944	3	magnolia, sweetbay	Good	5			
945	4	magnolia, sweetbay	Good	6			
946	8	zelkova, Japanese	Good	12			
947	12	arborvitae, eastern	Poor	18			Poor Structure, cable and brace or remove extra stem
948	4	holly, Chinese	Fair	6			
949	7	holly, Chinese	Fair	11			Poor Structure,
950	5	holly, Chinese	Poor	8			Poor Structure,
951	6	maple, Norway	Fair	9			Poor Structure,
952	4	dogwood, Kousa	Fair	6			Mechanical Damage,
953	6	holly, Foster's	Fair	9			Mechanical Damage,
954	11	planetree, London	Poor	17			Poor Structure, bent bole
955	12	maple, Norway	Poor	18			Poor Structure,
956	9	planetree, London	Fair	14			Poor Structure,
957	5	holly, Foster's	Fair	8			Poor Structure,
958	6	holly, Foster's	Fair	9			Poor Structure,
959	12	maple, red	Fair	18			Signs of Stress, too close to fire hydrant
960	9	planetree, London	Fair	14			Poor Structure, bent bole
961	8	planetree, London	Fair	12	X		Poor Structure, bent bole
962	10	planetree, London	Fair	15	X		Poor Structure, bent bole
963	12	planetree, London	Fair	18	X		Mechanical Damage,
964	2	cedar, Atlas	Fair	3	X		Signs of Stress,

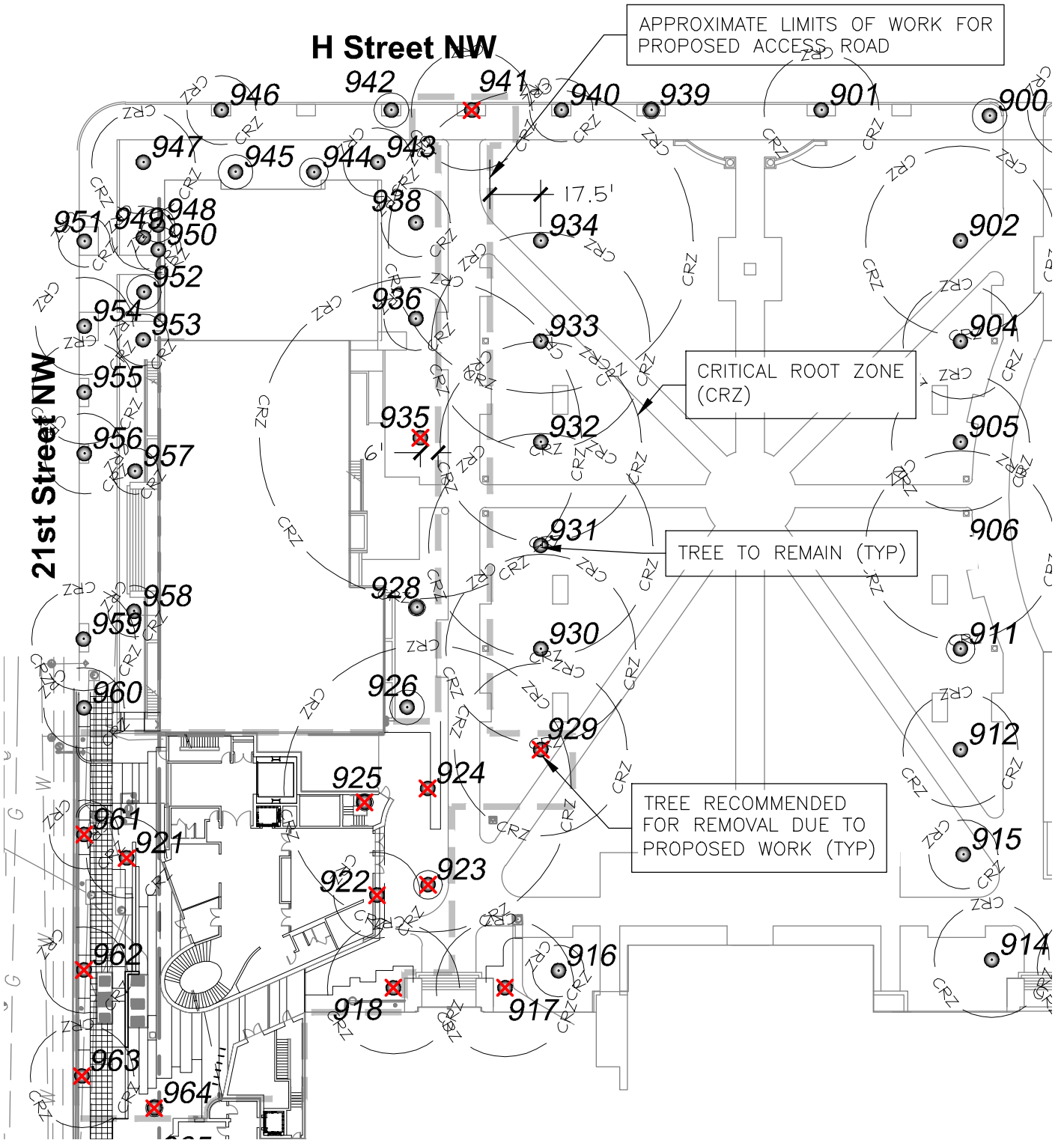
Conclusion

Due to the significant impacts to the trees on the site and the added cost of the required protection measures, an alternative layout that would avoid the CRZs of trees should be considered.

ⁱ **Critical Root Zone (CRZ):** Described as the minimum area of tree roots required to be protected to maintain tree health. Estimated area is based upon an industry standard “rule of thumb” of 1.5 feet of radius per inch of diameter at breast height (DBH). Any impacts within the CRZ must be mitigated based on severity up to and including tree removal if the impact is severe.

ⁱⁱ **Tree Protection Area (TPA):** general term referring to the overall protected area around a given tree or group of trees.

ⁱⁱⁱ **Arborist Disclosure Statement:** Arborists are tree specialists who use their education, knowledge training and experience to examine trees, recommend measures to enhance their health and beauty and to attempt to reduce the risk of living near trees. Clients may choose to accept or disregard the recommendations of the arborist or to seek additional advice. Trees and other plant life are living, changing organisms affected by innumerable factors beyond our control. Trees fail in ways and because of conditions, we do not fully understand. Arborists cannot detect or anticipate every condition or event that could possibly lead to the structural failure of a tree. Conditions are often hidden within the trees and below ground. Arborists cannot guarantee that a tree will be healthy or safe under all circumstances, for any specific period or when a tree or its parts may fail. Further, remedial treatments, as with any treatment or therapy, cannot be guaranteed. Treatment, pruning, bracing and removal of trees may involve considerations beyond the scope of the arborists skills and usual services such as the boundaries of properties, property ownership, site lines, neighbor disputes and agreements and other issues. Therefore, arborists cannot consider such issues unless complete and accurate information is disclosed in a timely fashion. Then, the arborist can be expected, reasonably, to rely upon the completeness and accuracy of the information provided. Trees can be managed but not controlled. To live near trees, regardless of their condition, is to accept some degree of risk. The only way to eliminate all risk associated with trees is to eliminate all trees.



DAVEY
RESOURCE GROUP
A Division of The Davey Tree Expert Company



**CRITICAL ROOT ZONE (CRZ) OVERLAY
 THE GEORGE WASHINGTON UNIVERSITY MUSEUM
 WASHINGTON D.C.**

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 National 877.818.7337

SCALE: 1" = 50'

DATE: 4 OCT 2011