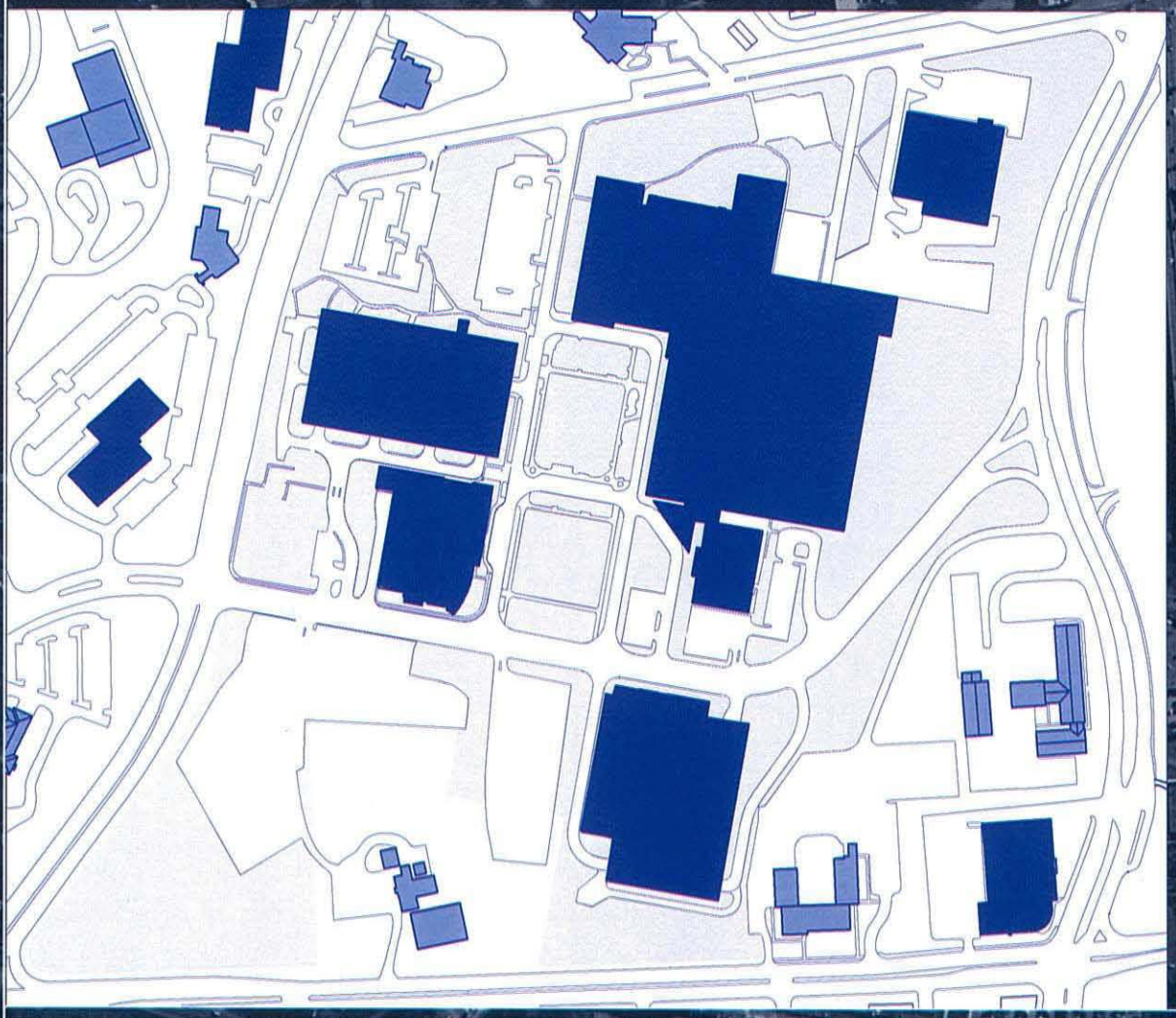

UMass Medical Center Master Plan

Massachusetts State Project UMW 0301 ST1
Volume III

Campus Plan

- Executive Summary
- Site Analysis
- Campus Plan Concept Studies
- Proposed Campus Plans
- Campus Phasing Plan
- Proposed Landscape Plan
- Design Guidelines
- Projected Area Summaries
- Civil Site Plan
- Infrastructure Report and Plan
- Traffic Study
- Cost Estimate Scenarios
- Steering Committee Meeting Reports
- Education User Group Meeting Reports

Tsoi/Kobus & Associates
TK&A #23024-000
November 2005

University of Massachusetts Medical School

Division of Capital Asset Management

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University of Massachusetts Medical School

Section I. Executive Summary

EXECUTIVE SUMMARY

The University of Massachusetts Medical School's main campus in Worcester, Massachusetts occupies 52.5 acres bounded east to west by Lake Avenue and Plantation Road and north to south by North Road and Belmont Road/Route 9. While the School has research and education programs at several off-campus locations, including the Massachusetts Biotechnology Park and Worcester State Hospital campus directly across Plantation Road, the focus of this planning study is limited to the main campus boundaries.

TK&A conducted the campus planning studies concurrently with the programming phase. As program projections evolved through the visioning sessions and education programming workshops, site development options were evaluated in tandem. Feedback from UMMS Steering Committee meetings, a DCAM Global Review meeting and interim consultant working sessions with DCAM and UMMS representatives, was incorporated into each option.

Planning Objectives

Guiding the campus planning process were the following institutional goals:

- Establish Optimum Holding Capacity
- Identify Infrastructure Demands
- Enhance Collaborative Community
- Transform Image to Academic Campus
- Create Flexible Phasing Strategy
- Increase Nursing and PhD Programs

Additionally, the master plan is intended to create a long-range vision that embraces:

- Sustainable design principles: The master plan should incorporate siting and building design concepts which incorporate the philosophical precepts of green design, including the use of passive energy saving elements. Incorporated into this should be planning for how deferred maintenance can be accomplished in such a manner as to enhance the green aspects of building repair and renovation. Use the LEED program as a guide to determine efficiency of proposed green design.
- Accessibility: UMMS's ADA transition plan is ongoing and outside of the scope of the study, however this study encourages future site development that recognizes the challenges of the topography, minimizes the need for ramps and lifts and breaks up long walking distances with benches and resting places.
- Off Campus Synergies: while the programming study recommends consolidating a number of education and research activities to the main campus, some programs are likely to remain off campus in the near to long-term. It is the intent of this plan to enhance interaction among these locations and programs (such as Commonwealth Medicine), while not precluding the potential for a

"west campus" expansion across Plantation Road or the acquisition of contiguous parcels along the Route 9 frontage between Lake Avenue and Plantation Road.

- Student Housing Need: As the master plan progressed, the administration recognized an emerging trend at peer institutions to provide graduate student housing and rising rental costs in the Worcester area. It is believed that not offering housing is becoming a competitive disadvantage especially when recruiting students from abroad. Potential locations, on campus and off campus, were discussed including the southeast quadrant of the campus with a lake orientation, the State Hospital campus to the east on the hill and other off campus locations in close proximity. It was agreed that further determination of need and a site selection process are required.

Phasing Objectives

Recognizing the rapidly evolving nature of life sciences and healthcare, the campus plan and phasing strategy is designed to be flexible. The tripartite mission of today's academic medical center is merging into a single mission with blurring boundaries as translational medicine, clinical research and curriculum reform bring the realms of healthcare, research and education closer together in day-to-day practice.

As the University looks forward to growing all aspects of this interrelated enterprise, a flexible phasing scenario was developed that is capable of accommodating equally well both today's priorities and tomorrow's. See Section V for detailed phasing plan.

Recommendations

The following pages illustrate the site analysis and campus plan concept options that informed the final proposed campus plan. The intent of the proposed plan is further elaborated with a landscape plan, design guidelines and engineering reports.

Key recommendations resulting from this study include:

- *Land Acquisitions* To accommodate the proposed programs, land acquisition would be required along the Route 9 frontage. Inclusion of these three outparcels within the main campus boundaries would relieve the need for extensive below-grade parking structures, allow space for the hospital's maximum foreseen growth potential and provide a mixed-use cluster on the southern quadrants to accommodate Commonwealth Medicine, student housing, joint biotech ventures, retail, campus amenities or other unforeseen programs on campus.
- *Infrastructure Loop* A second power plant location in combination with the completion of the buried infrastructure loop is recommended to relieve the risks associated with a single-point power and steam supply to critical campus functions.

- *Pedestrian Lawn* To achieve the desired academic campus image and promote a collaborative culture, it is recommended that the existing quadrangle be developed into separate pedestrian and vehicular zones. With the acquisition of the Department of Youth Services parcel, this central quadrangle could be extended south to Route 9 to establish a visible identity to the campus with the proposed retention pond as a landmark feature.

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University of Massachusetts Medical School

Section II. Site Analysis

SITE ANALYSIS

Issues studied in the site analysis are shown in Figures 1 to 15 and included the following:

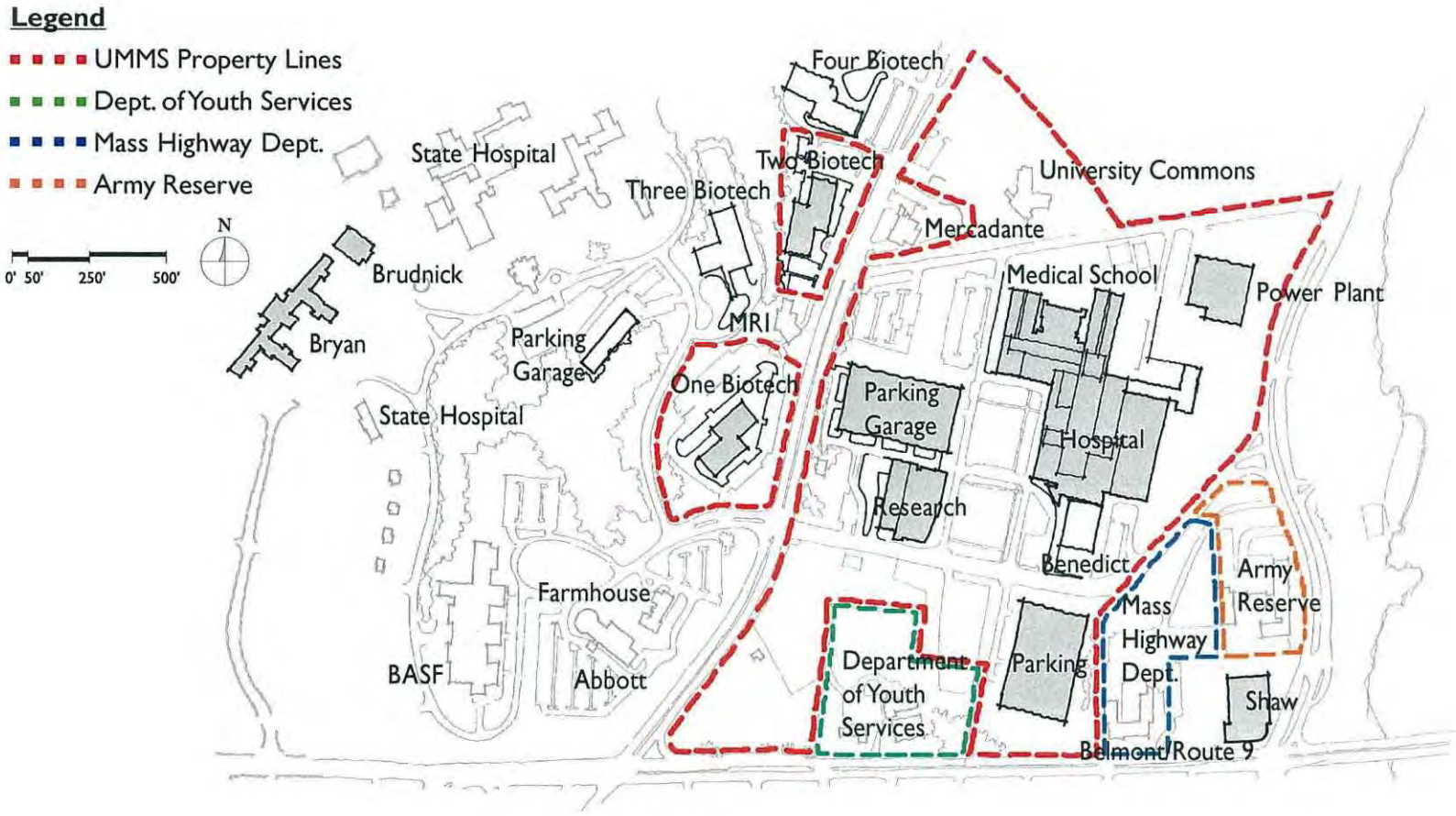
- Campus Boundaries showing Existing Property Lines (Figure II.1)
- Site Topography including Hillside Slopes and Site Platforms (Figures II.2 and II.3)
- Regional Edges (Figure II.4)
- Campus Edges and Conditions showing an interpretive diagram of the existing campus environment (Figure II.5)
- General Campus Wide Use Diagram (Figure II.6)
- Automobile Traffic Nodes (Figure II.7)
- Existing Parking and Loading Dock Locations (Figure II.8)
- Building Front Doors and Important Destination Points (Figure II.9)
- Inside Spaces (Figure II.10)
- Outside Spaces (Figure II.11)
- Campus Utilities (Figure II.12)
- Defining Campus Spaces - Showing Important Edges and Entries (Figure II.13)

Additional diagrams showing proposed design intent were provided at this time. They are shown in Figure 16. These include the following:

- Ideal Campus Edges, Defining Spaces
- Proposed Campus and Building Entry Locations

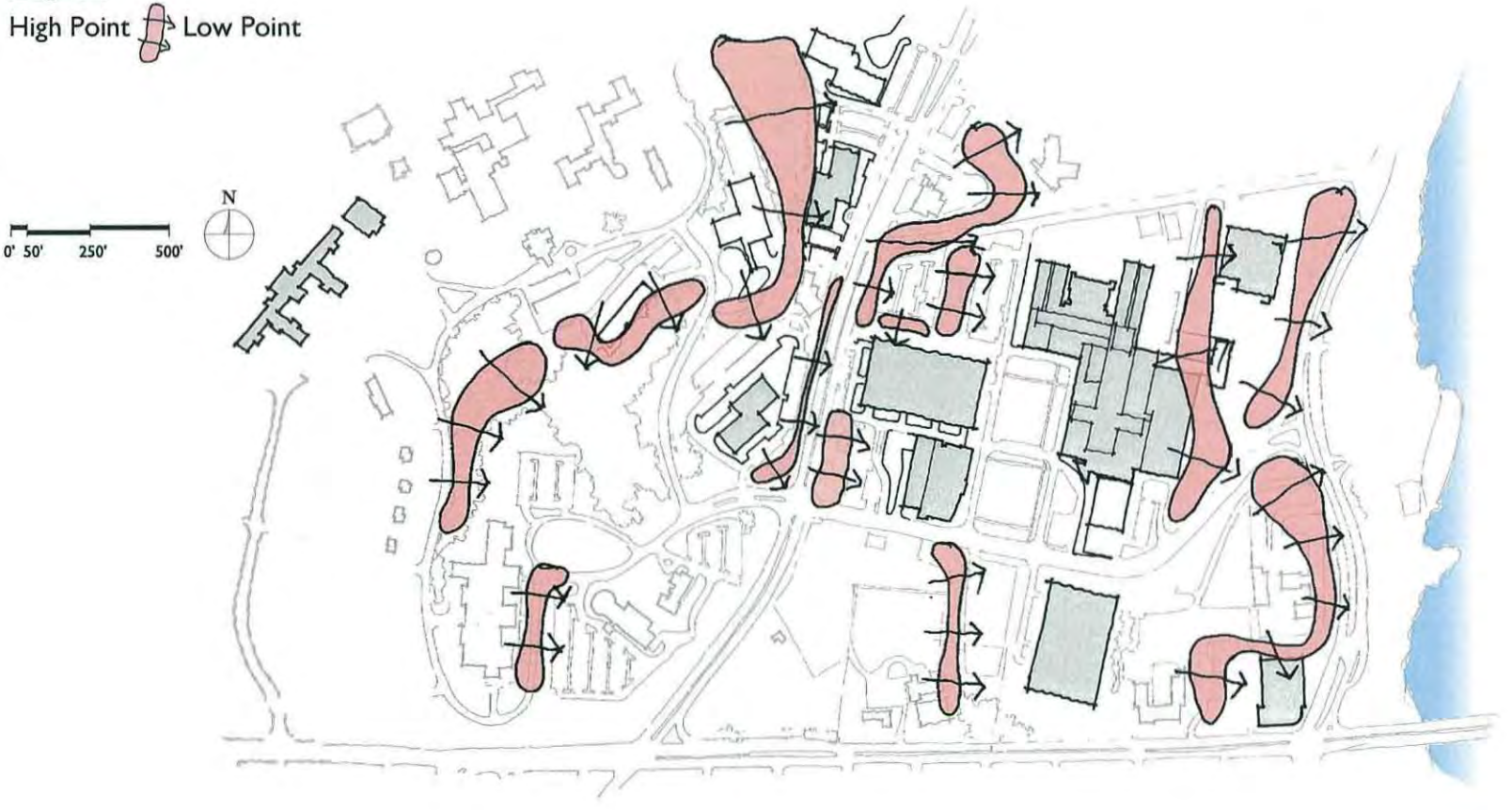
UMMS Campus Boundaries

Figure II.1



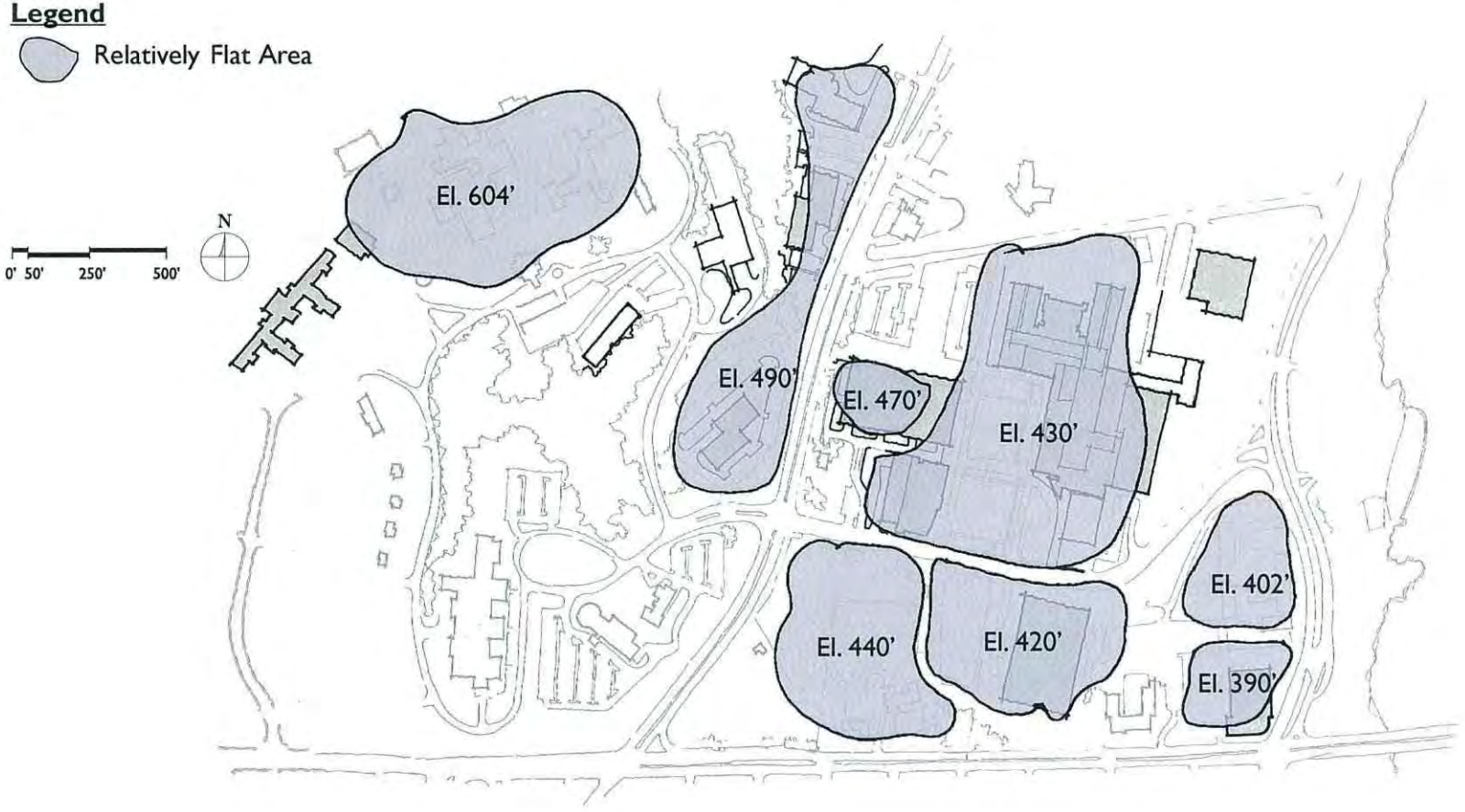
Site Topography
Hillside Slopes

Figure II.2



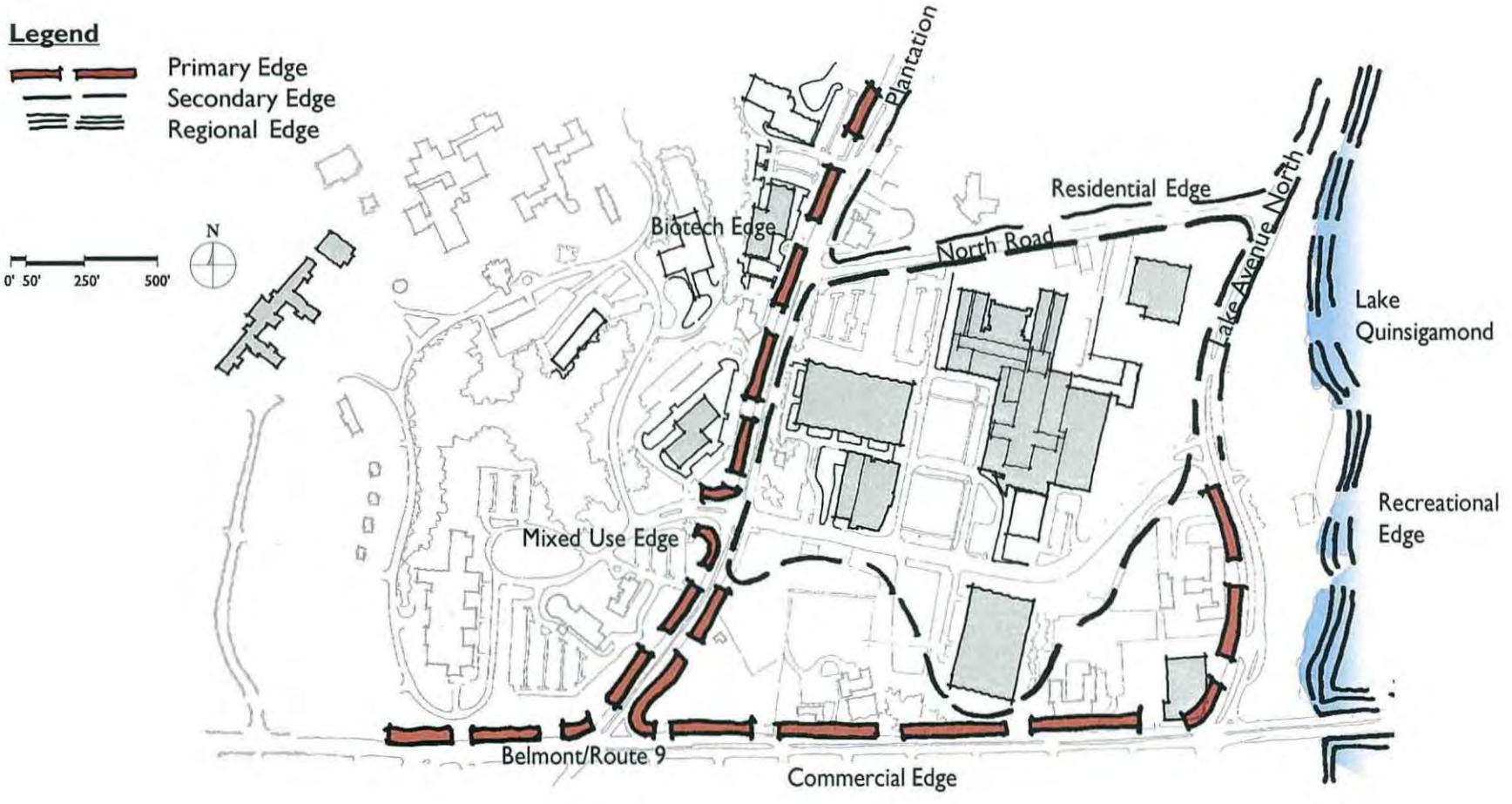
Site Topography
Site Platforms

Figure II.3



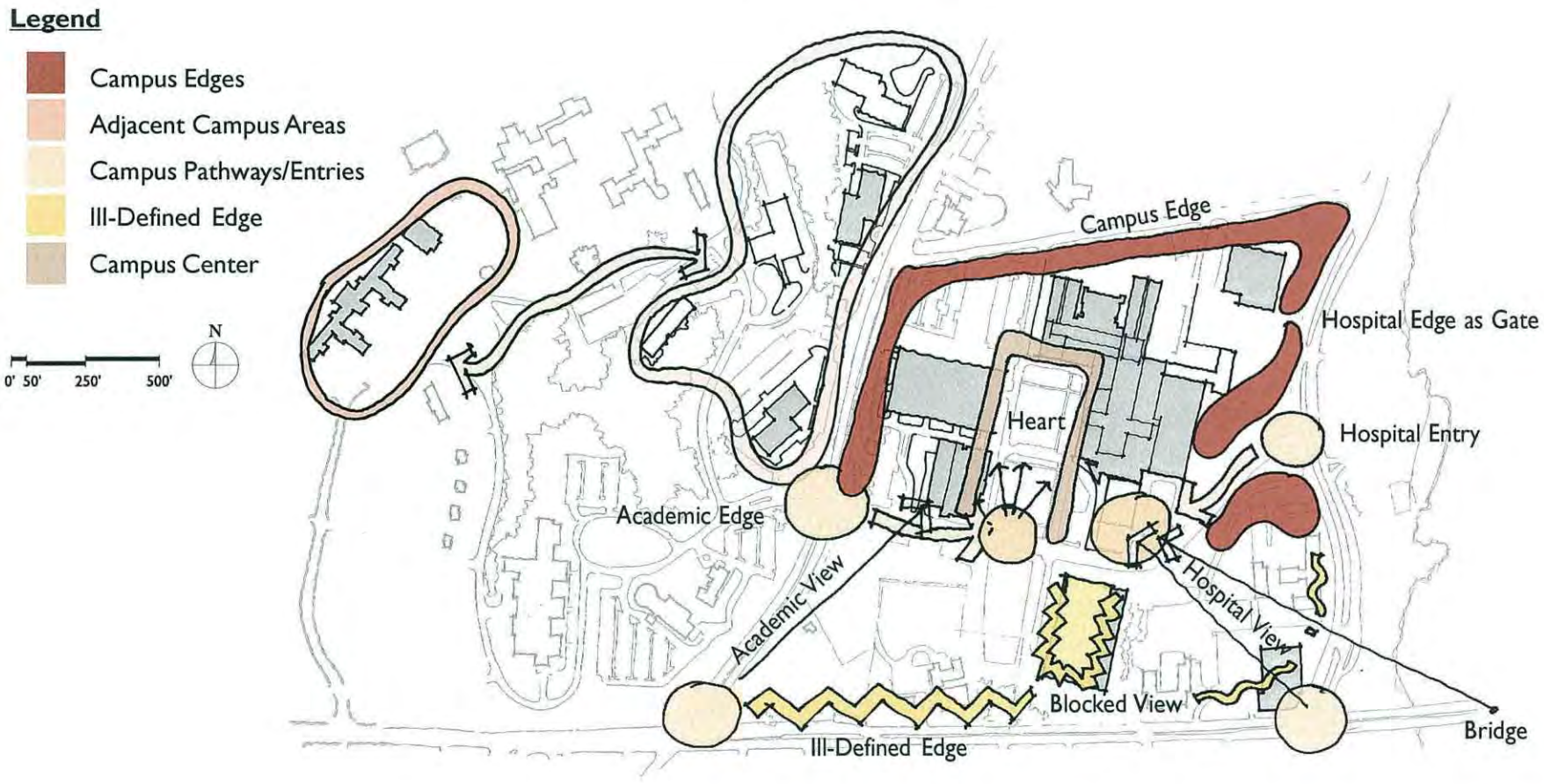
Regional Edges

Figure II.4



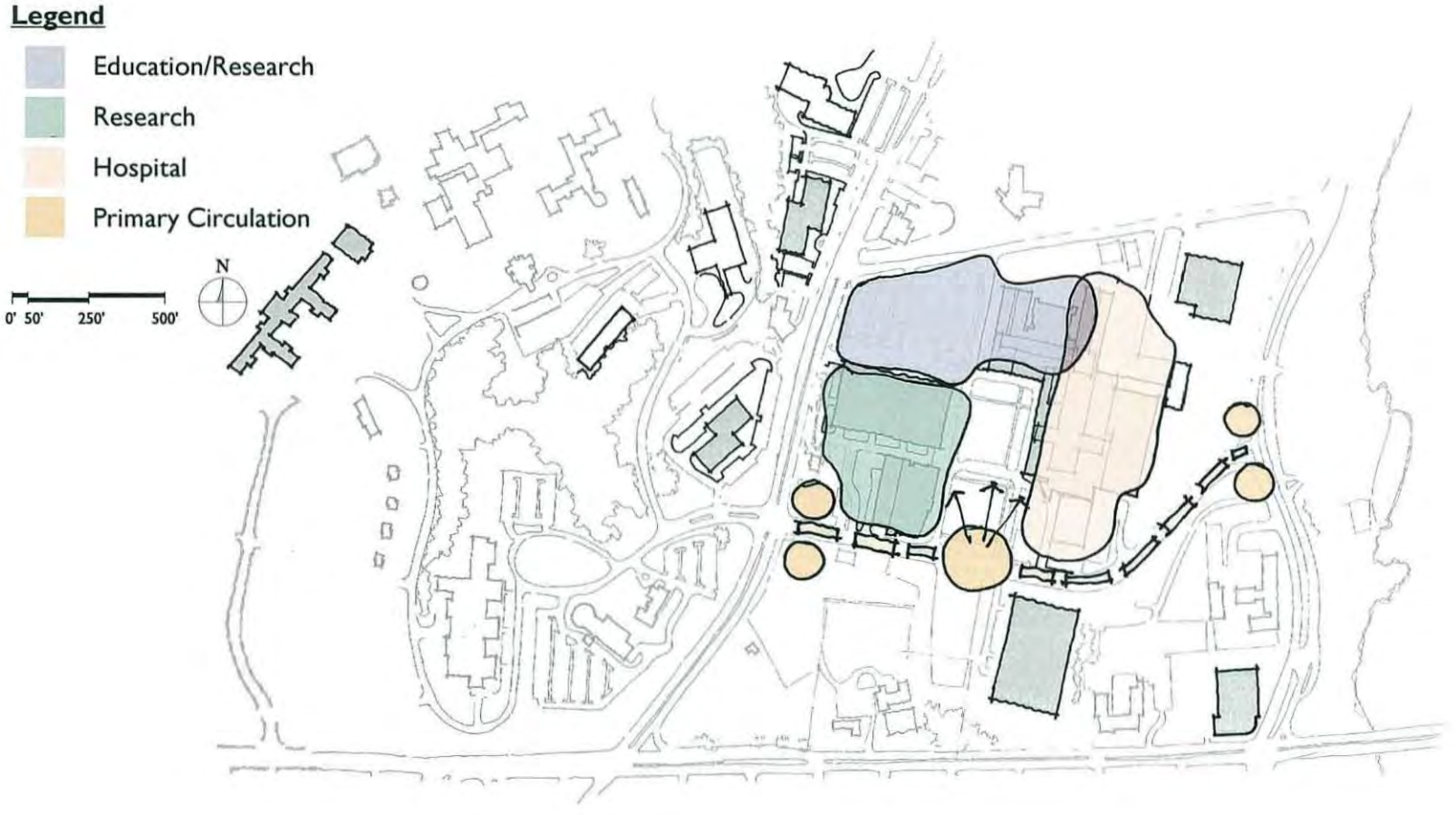
Campus Edges
Existing

Figure II.5



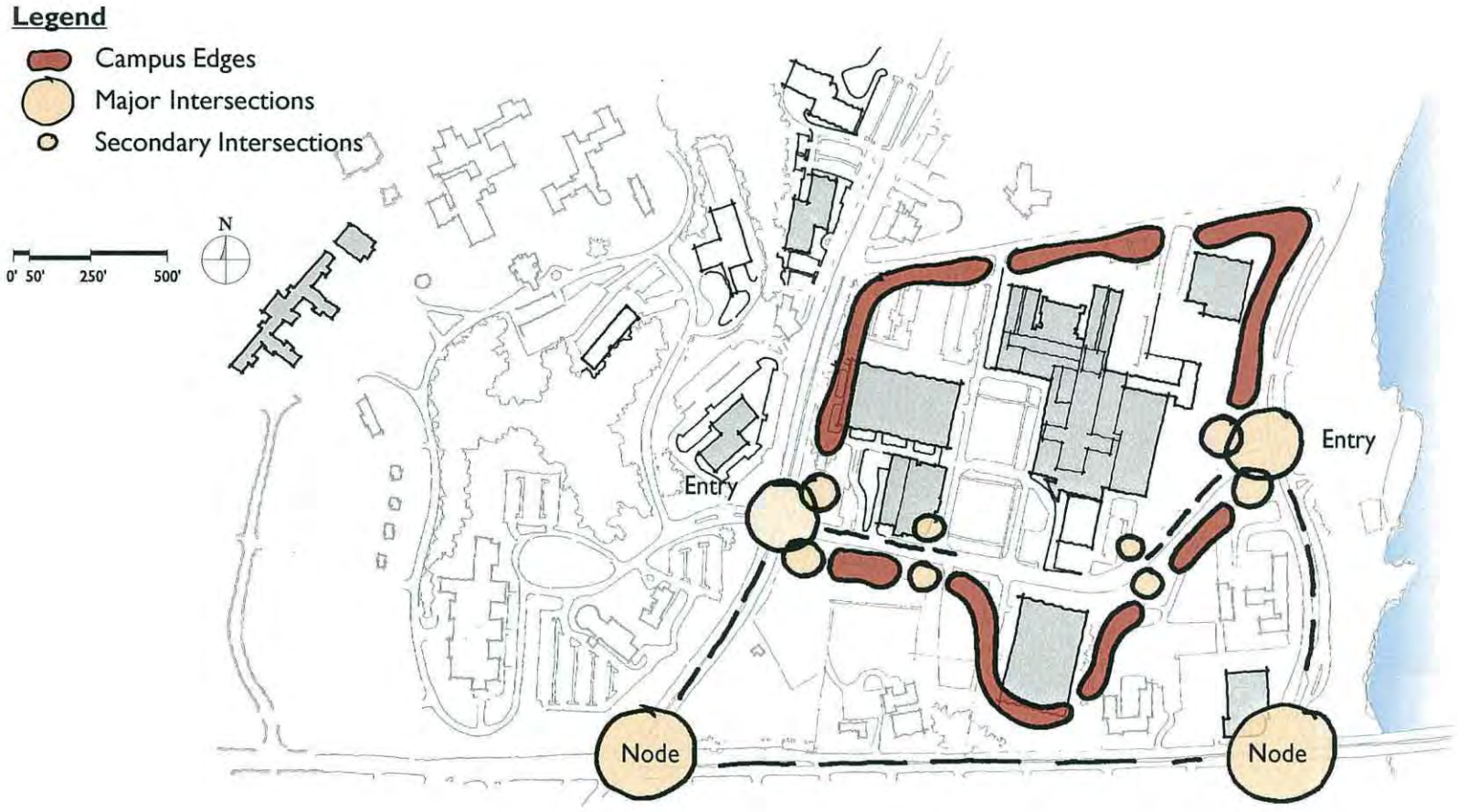
General Campus-Wide Use

Figure II.6



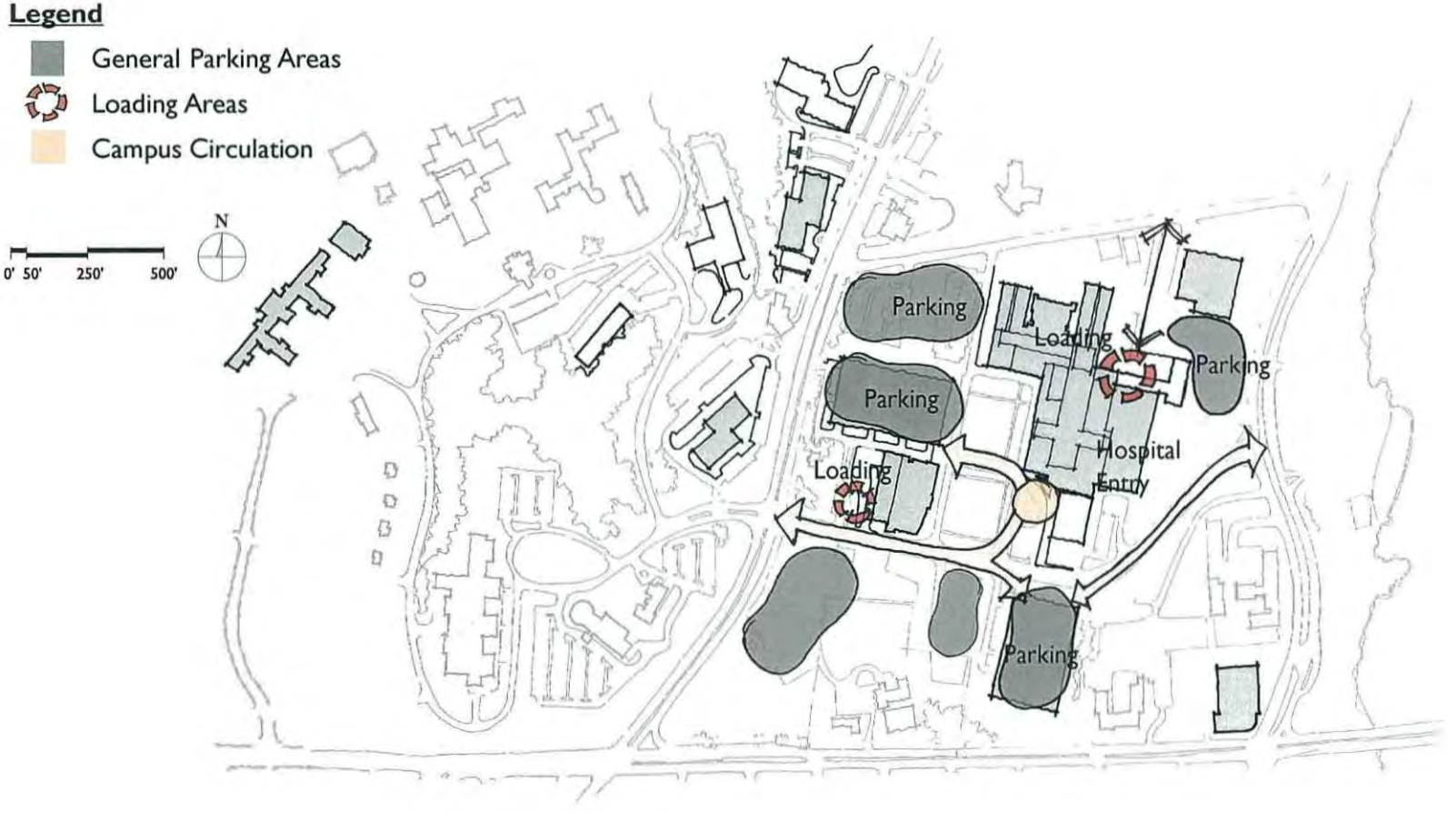
Existing Automobile Traffic Nodes

Figure II.7



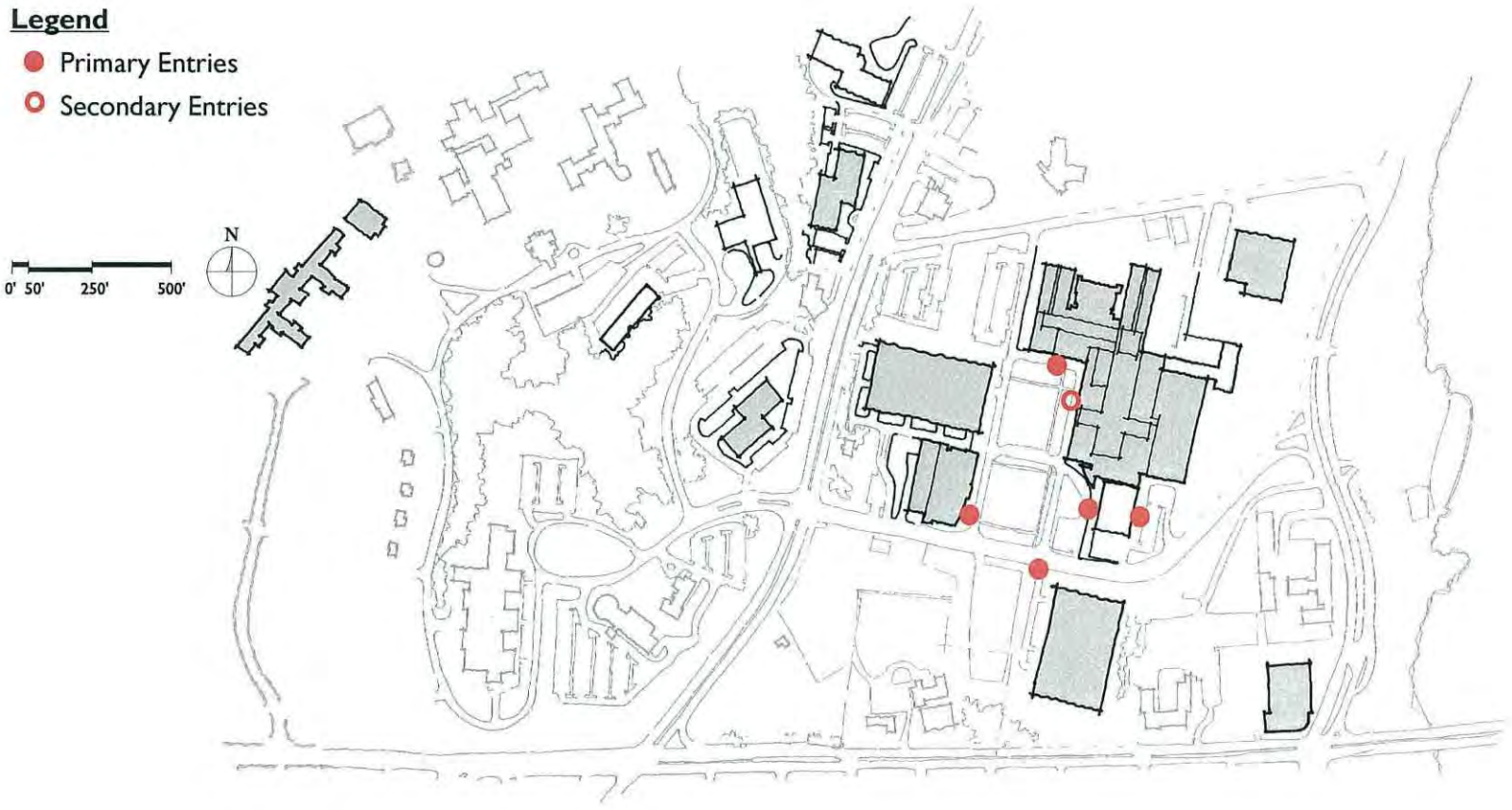
Existing Parking & Loading Dock Locations

Figure II.8



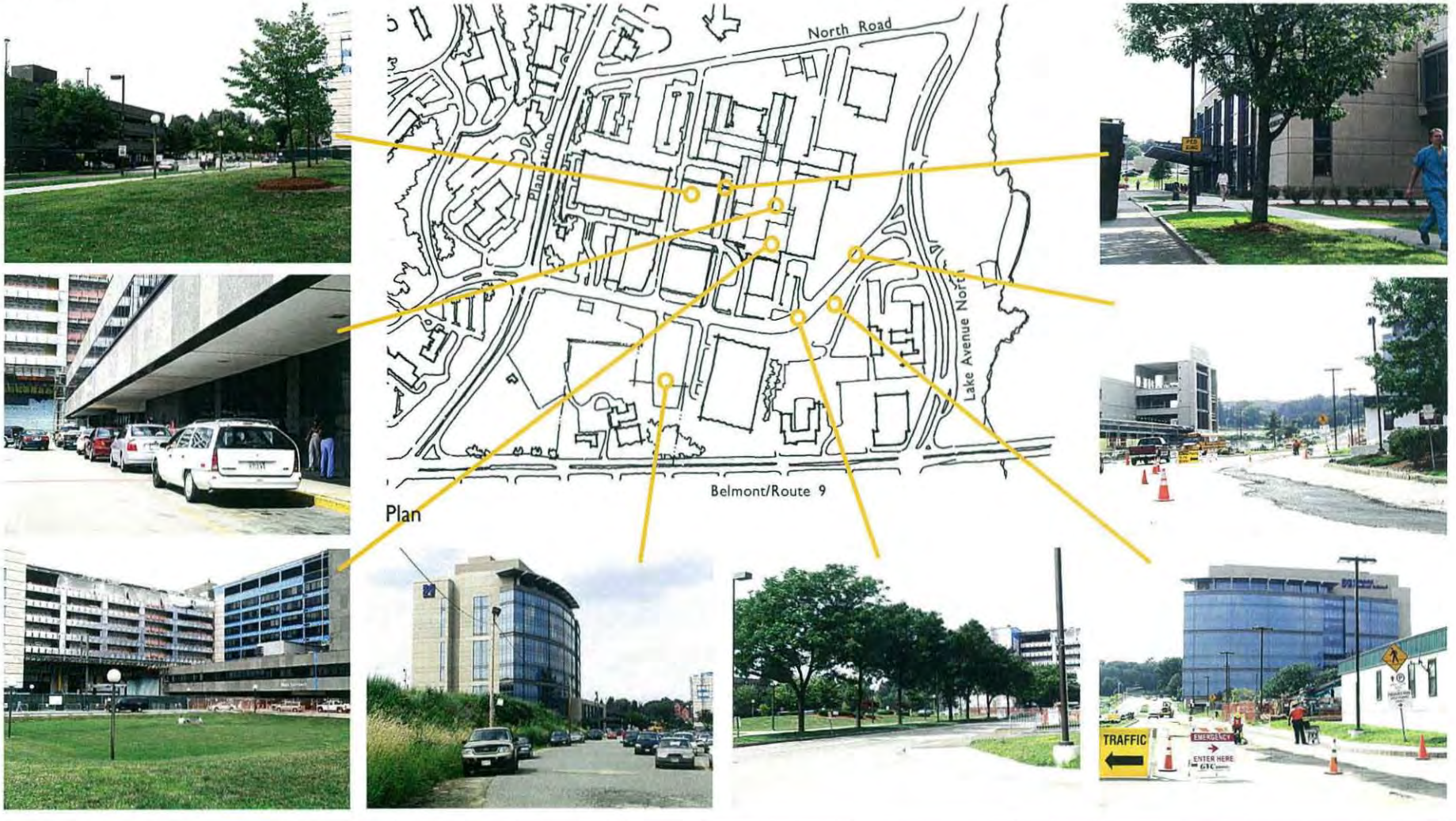
Building Front Doors & Important Destination Points

Figure II.9



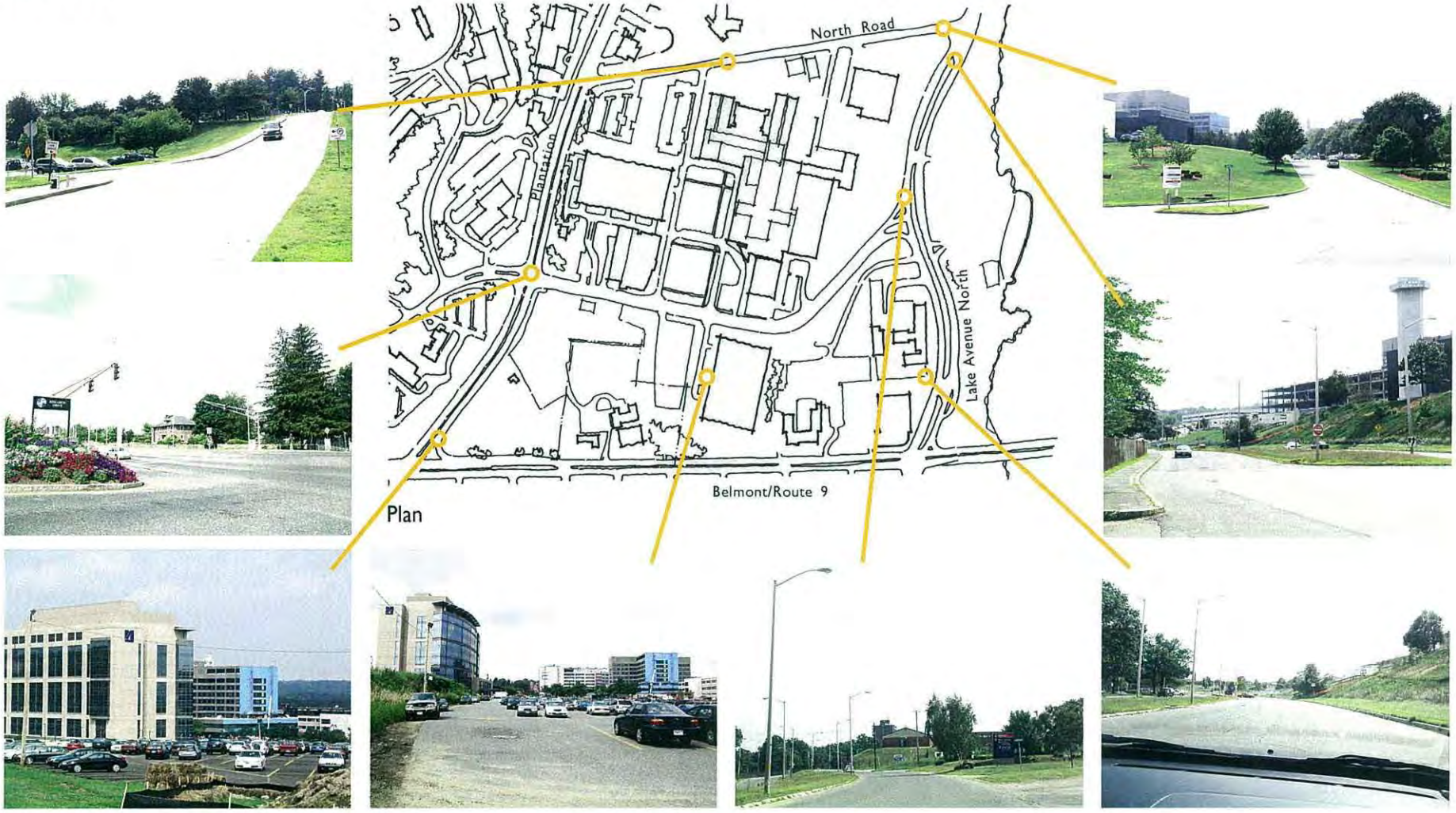
Inside Spaces

Figure II.10



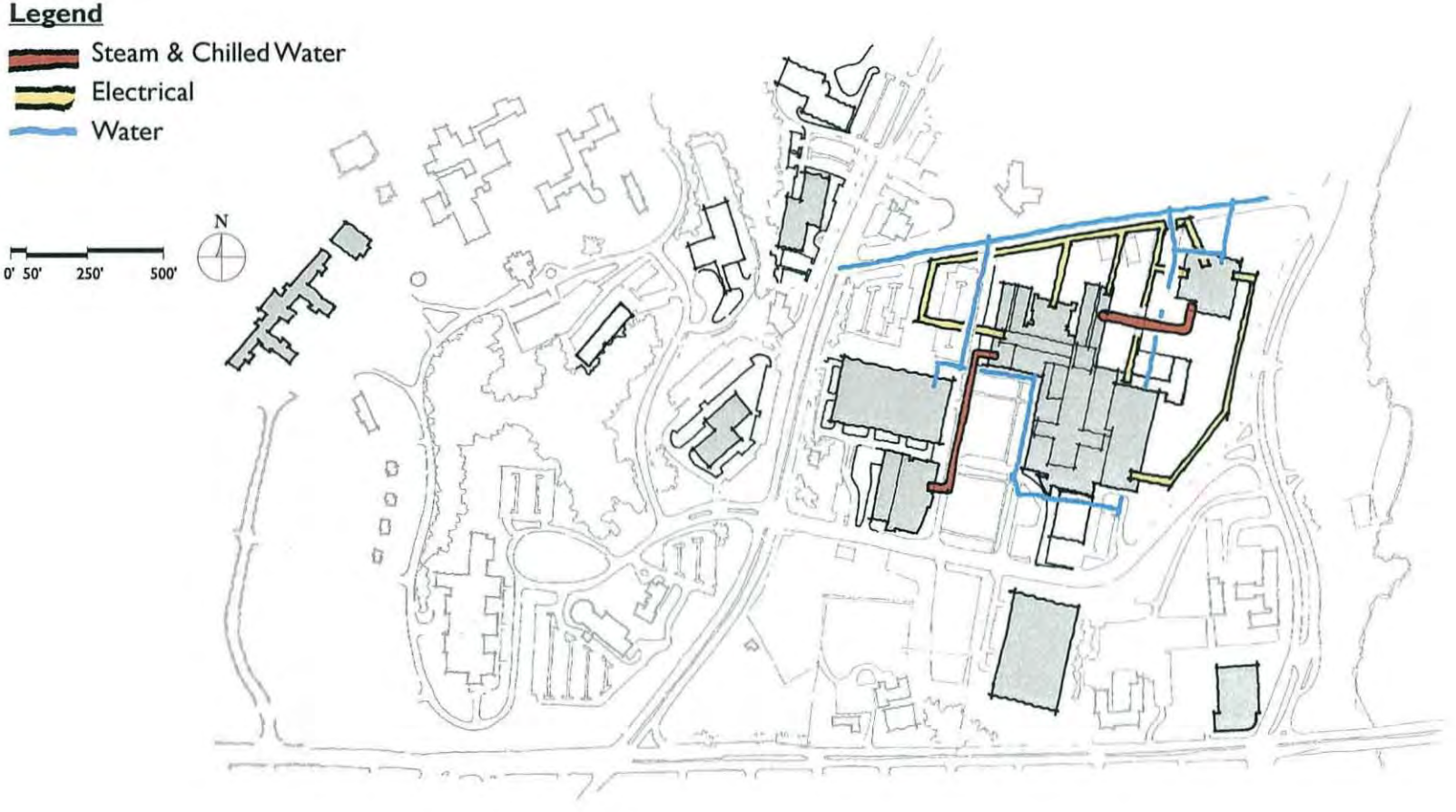
Outside Edges

Figure II.11



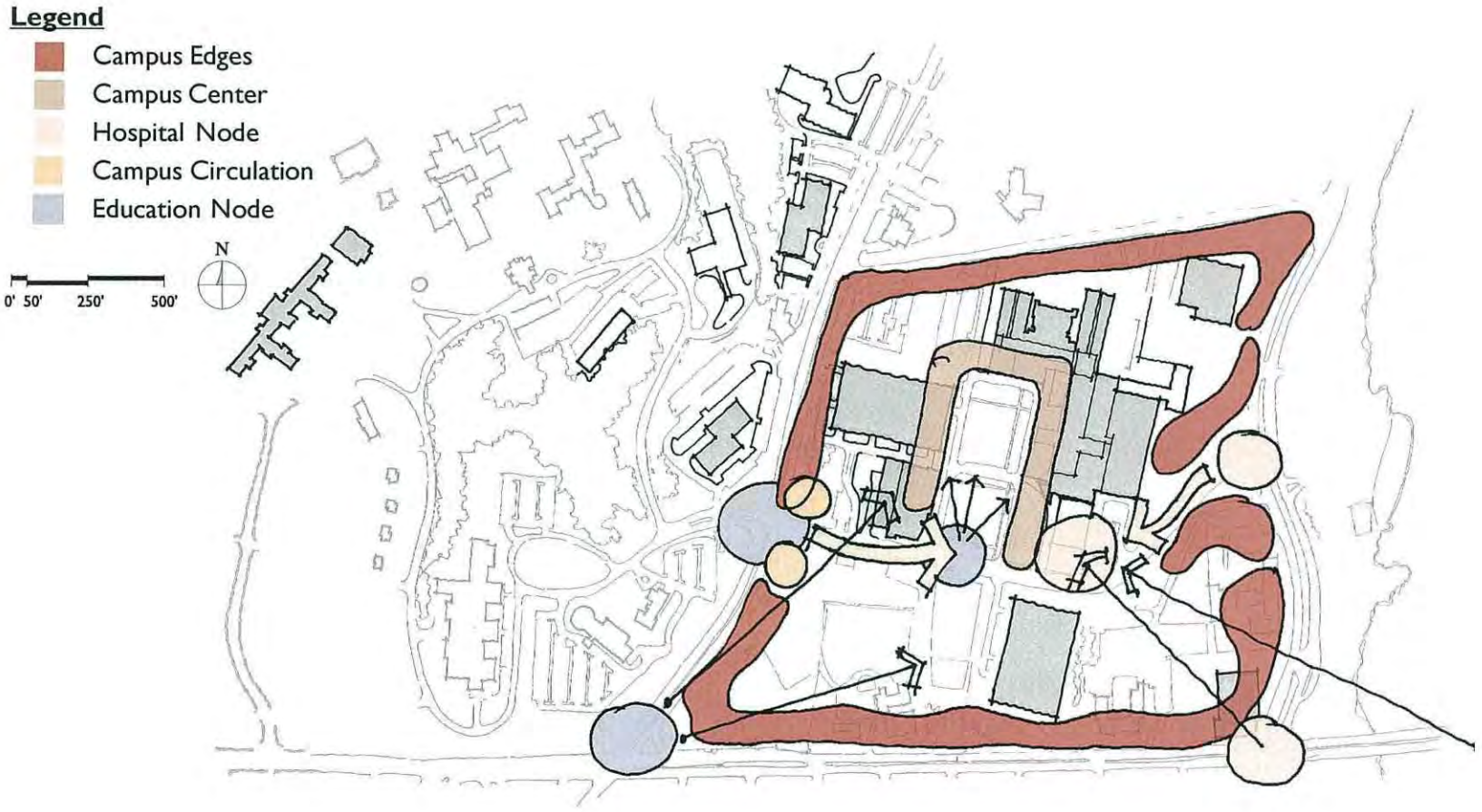
Campus Utilities

Figure II.12



Defining Campus Spaces

Figure II.13



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Section III. Campus Plan Concept and Capacity Studies

CAMPUS PLAN CONCEPT AND CAPACITY STUDIES

Campus Concept Options

Three Campus Concept Plans were developed. The intent of these studies was to explore ways of organizing the overall campus design.

- The "Campus Quad" (Figure III.1)
  Created a large single campus quadrangle open at one end to Belmont Street and for pedestrian use only. Access to the campus is through South Road.
- The "Auto Court" (Figure III.2)
  Allowed automobile traffic to come into the center of the site through a formal campus entry off Belmont Street.
- "A Green Buffer Along Route 9" (Figure III.3)
  This concept diagram showed a smaller, central pedestrian quad adjacent to South Road with the creation of a wide green buffer zone along the full length of the campus edge facing Route 9.

Campus Concept and Capacity Studies

Each of the above three concepts was then explored further. The purpose of these studies was to explore the holding capacity of the campus along with the structured parking to support the program expansion. Phasing options were also explored. Figures III.4 to III.12 analyze general campus capacities.

The three capacity option studies summarize the potential use distribution and optimum density of each of the three major campus concepts. Figures III.13 to III.15 show three capacity options associated with the campus concept options.

A third series of campus capacity studies was developed showing high, medium and low building density or consolidation. Each is shown in Figures III.16 to III.22.

Preferred Campus Concept - Campus Quads and Green Buffer

A composite Concept Plan was agreed to, called "Campus Quads and Green Buffer."

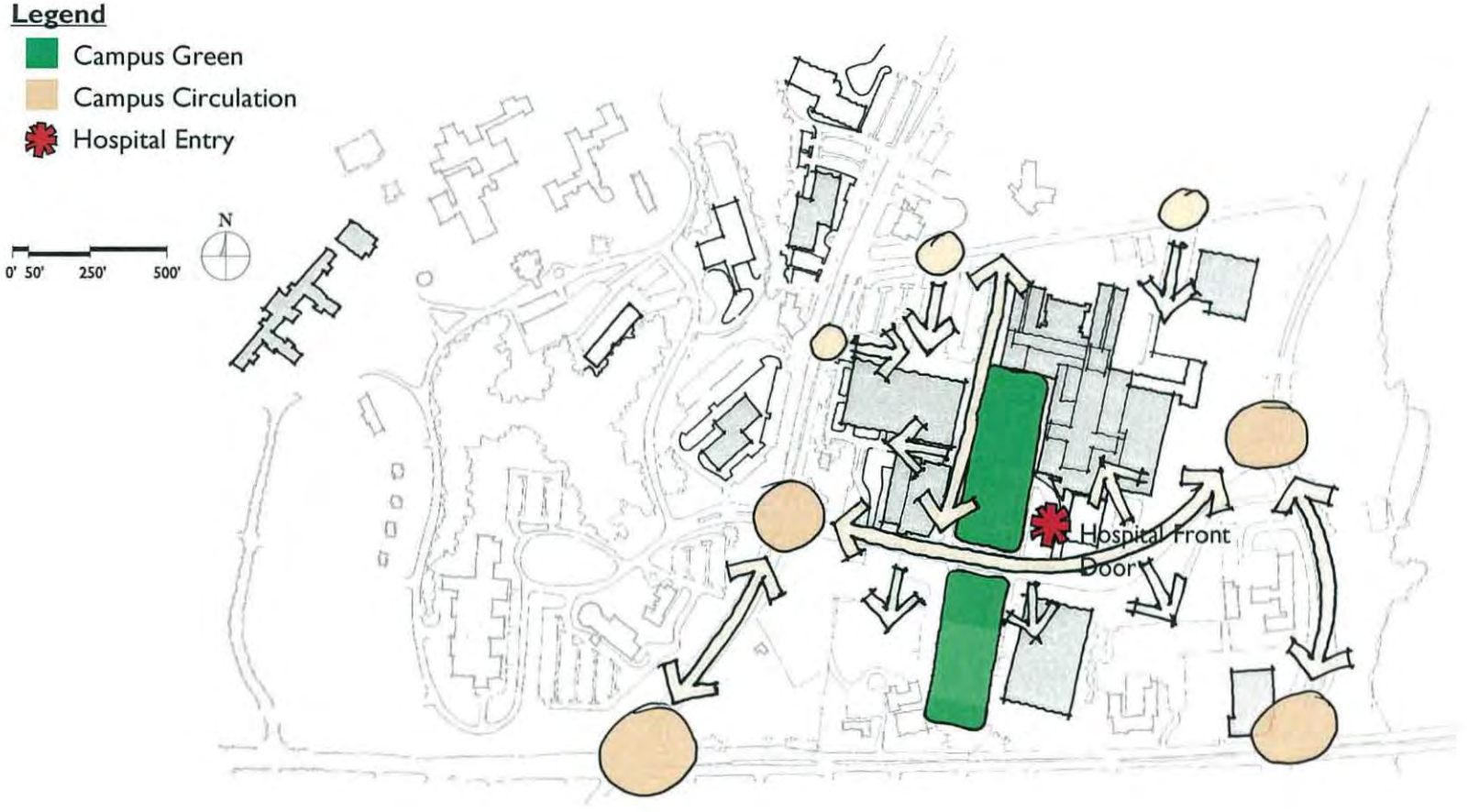
- "Campus Quads and Green Buffer" (Figure III.23)
  This plan calls for the establishment of a central quad that is accessible to automobiles but is largely dedicated to pedestrian use only. Autos may use that area of the quad that is immediately north of South Road to access the university hospital, the north campus quad and Lazare Building.

The Campus Plan developed further to include the establishment of smaller campus quads around the central common with a mix of above- and below-grade parking.

Campus Concept Options

Campus Quad

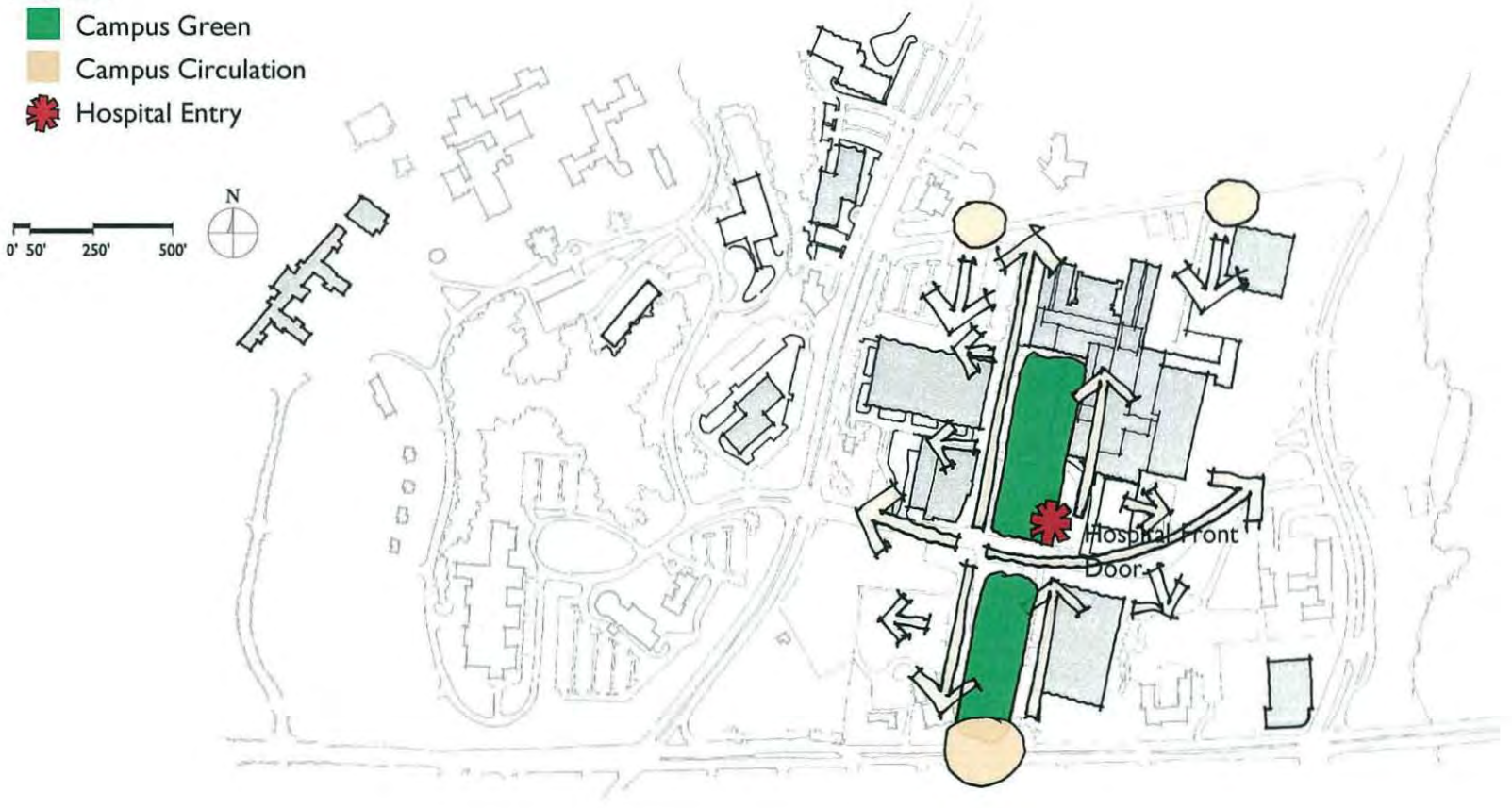
Figure III.1



Campus Concept Options

Auto Court

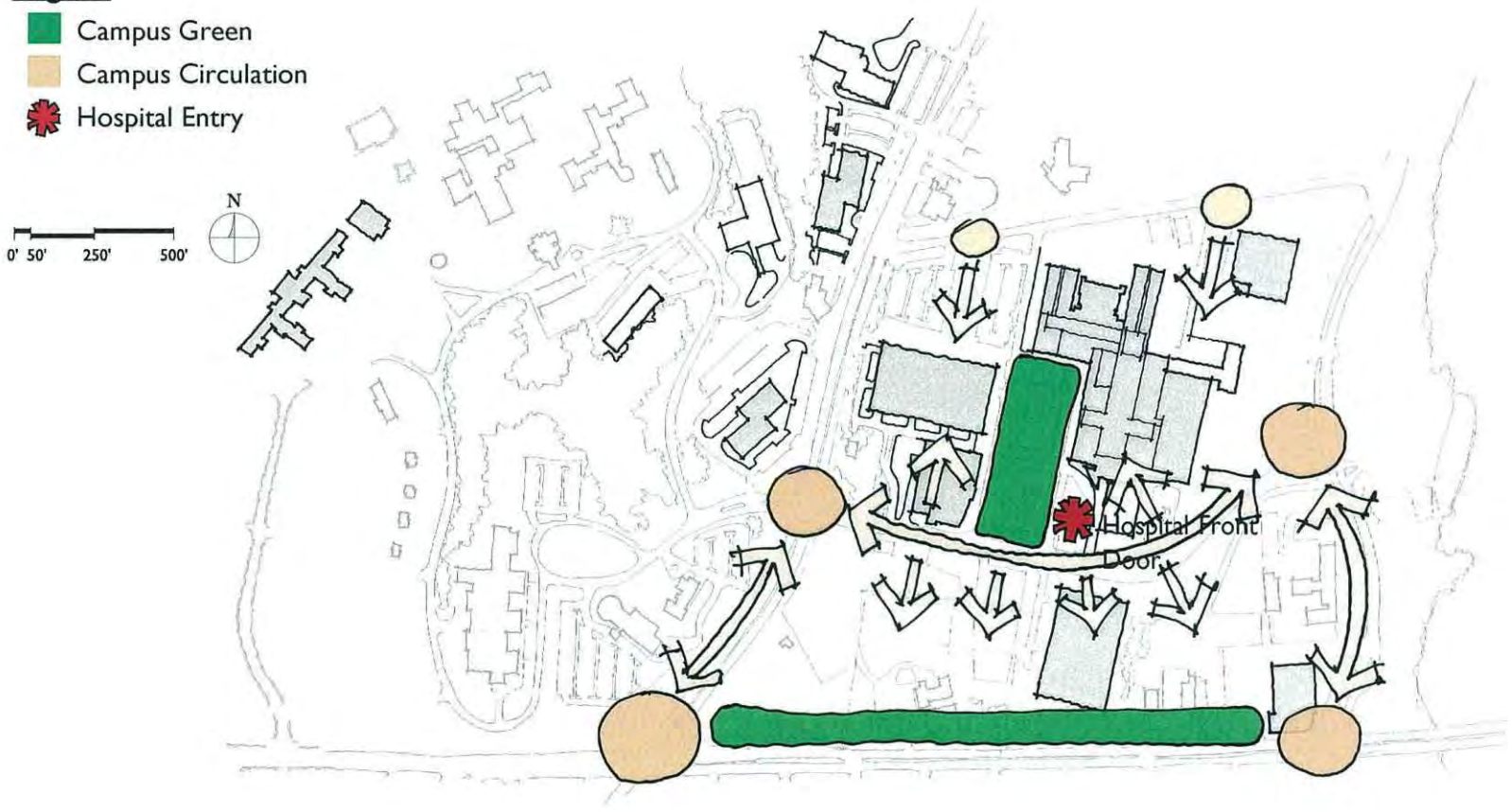
Figure III.2



Campus Concept Options

Green Buffer

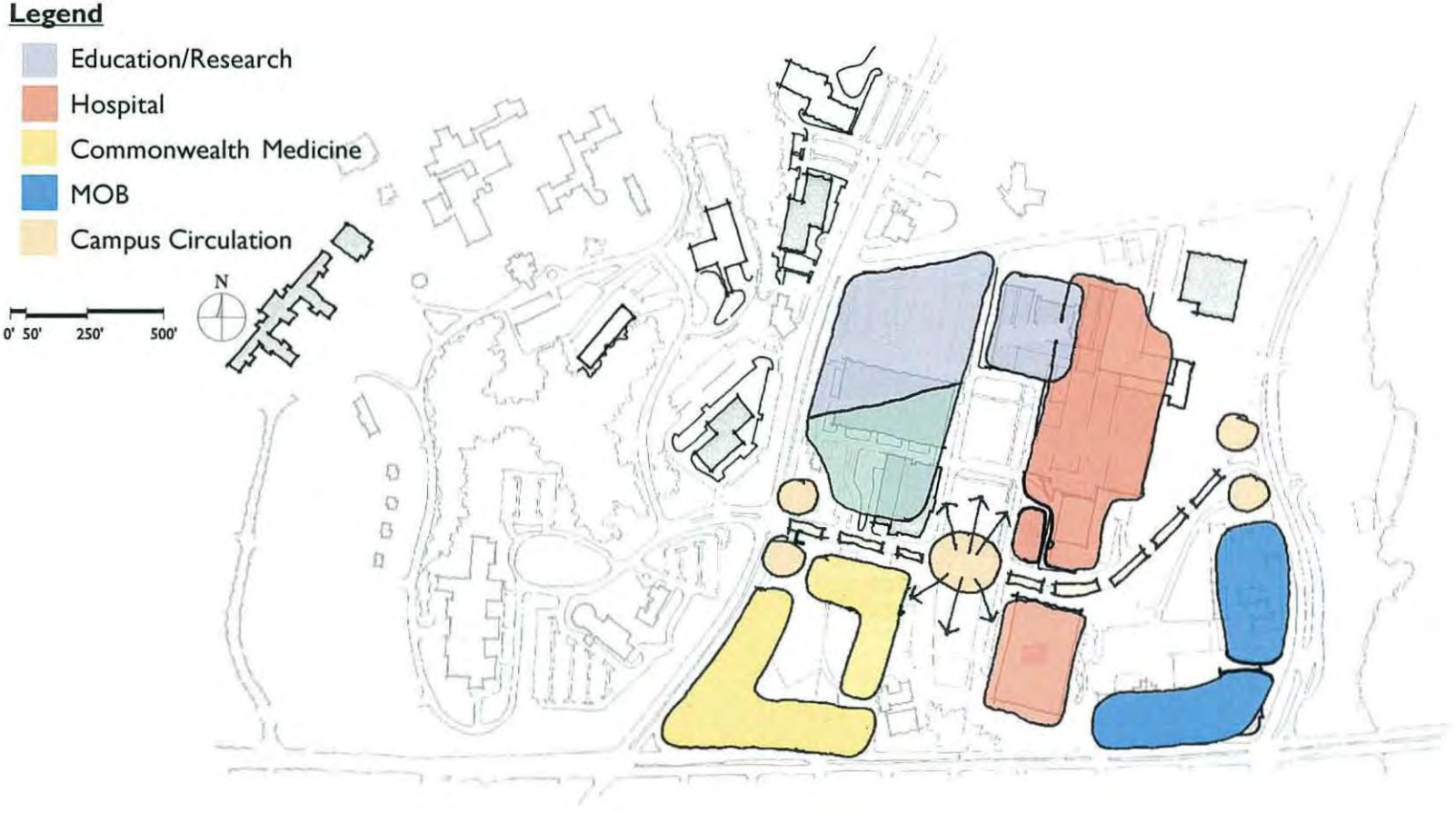
Figure III.3



Option 1 - Campus Quad

Use Diagram

Figure III.4



Option 1 - Campus Quad
Phase 1

Figure III.5

Option 1 Phase 1 - 9 Buildings

Northwest Site

Building A	96,000 GSF on 4 levels	Research
Building B	1,009 spaces on 7 levels	Parking Structure
Building C	96,000 GSF on 4 levels	Academic
Building D	96,000 GSF on 4 levels	Research/Academic

Northeast Site

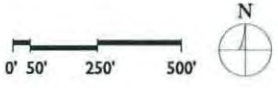
Building E	288,000 GSF on 4 levels	Hospital

- 120,000 GSF MOB (204 parking spaces in structures "B" & "G")
- 168,000 GSF Hospital (285 parking spaces in structures "B" & "G")

Southwest Site

Building F	81,000 GSF on 3 levels	Commonwealth Medical
Building G	1,189 spaces on 7.5 levels	Parking Structure
Building H	120,000 GSF on 3 levels	Commonwealth Medical
Building I	60,000 GSF on 4 levels	Academic

Parking 2,138 Cars	
Total Phase 1 Building	837,000 GSF
Total Existing	2,341,000 GSF
Total Build Out-Phase 1	3,178,000 GSF on 61.3 Acres
FAR 1.19	



Option 1 - Campus Quad
Phase 2

Figure III.6

Option 1 Phase 2 - 8 Buildings

Southwest Site

Building I	60,000 GSF on 4 levels	Academic
Building J	80,000 GSF on 4 levels	Research
Building K	75,000 GSF on 3 levels	Academic
Building L	645 spaces on 4.5 levels	Parking Structure

Southeast Site

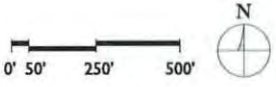
Building M	105,000 GSF on 3 levels	Medical Office Building
Building N	120,000 GSF on 3 levels	Medical Office Building
Building O	120,000 GSF on 3 levels	Research
Building P	1,035 spaces on 7 levels	Parking Structure

Total Phase 2

Building	560,000 GSF
Parking	1,680 Cars

Total Phases 1& 2 Building	1,397,000 GSF
Total Existing	2,341,000 GSF
Total Build Out	3,738,000 GSF on 67.4 Acres
FAR 1.27	

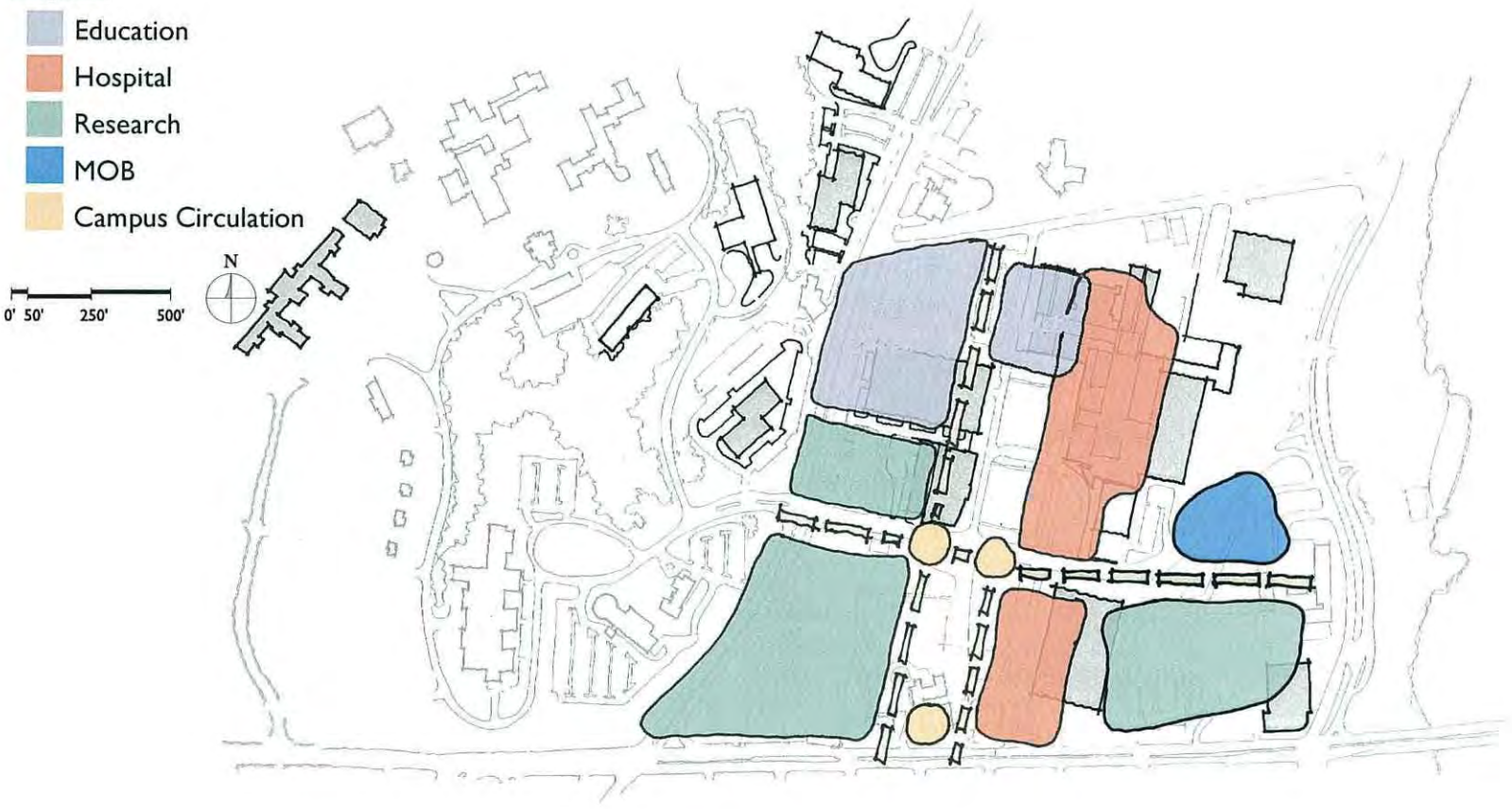
Total Parking 3,818 Cars



Option 2 - Auto Court

Figure III.7

Use Diagram

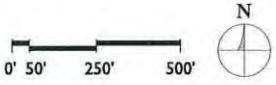


Option 2 - Auto Court
Phase I

Figure III.8

Option 4 Phase I - 6 Buildings

Northwest Site		
Building A	144,000 GSF on 4 levels	Academic
Building B	1,200 spaces on 8 levels	Parking Structure
Building C	96,000 GSF on 4 levels	Research
Building D	96,000 GSF on 4 levels	Commonwealth Medical
Northeast Site		
Building E	288,000 GSF on 4 levels	Hospital (192 parking spaces in structure "B"- remaining 300 parking spaces on grade)
Southwest Site		
Building F	96,000 GSF on 4 levels	Medical Office Building (163 parking spaces on grade)
Structured Parking		1,200 Cars
Total Phase I Building		720,000 GSF
Total Existing		2,341,000 GSF
Total Build Out-Phase I		3,061,000 GSF on 61.3 Acres
FAR 1.15		



Option 2 - Auto Court
Phase 2

Figure III.9

Option 4 Phase 2 - 11 Buildings

Southwest Site

Building F	120,000 GSF on 4 levels	Research/Academic
Building G	80,000 GSF on 4 levels	Research/Academic
Building H	120,000 GSF on 4 levels	Commonwealth Medical
Building I	120,000 GSF on 4 levels	Commonwealth Medical
Building J	1,320 spaces on 5.75 levels	Parking Structure

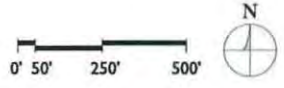
Southeast Site

Building K	1,169 spaces on 6 levels	Parking Structure
Building L	90,000 GSF on 3 levels	Research
Building M	90,000 GSF on 3 levels	Research
Building N	90,000 GSF on 3 levels	Research
Building O	63,000 GSF on 3 levels	Medical Office Building
Building P	90,000 GSF on 3 levels	Medical Office Building
	100 spaces on Grade	

Total Phase 2
Building 863,000 GSF
Parking 2,589 Cars

Total Phases 1& 2 Building	1,583,000 GSF
Total Existing	2,341,000 GSF
Total Build Out	3,924,000 GSF on 67.4 Acres
FAR 1. 34	

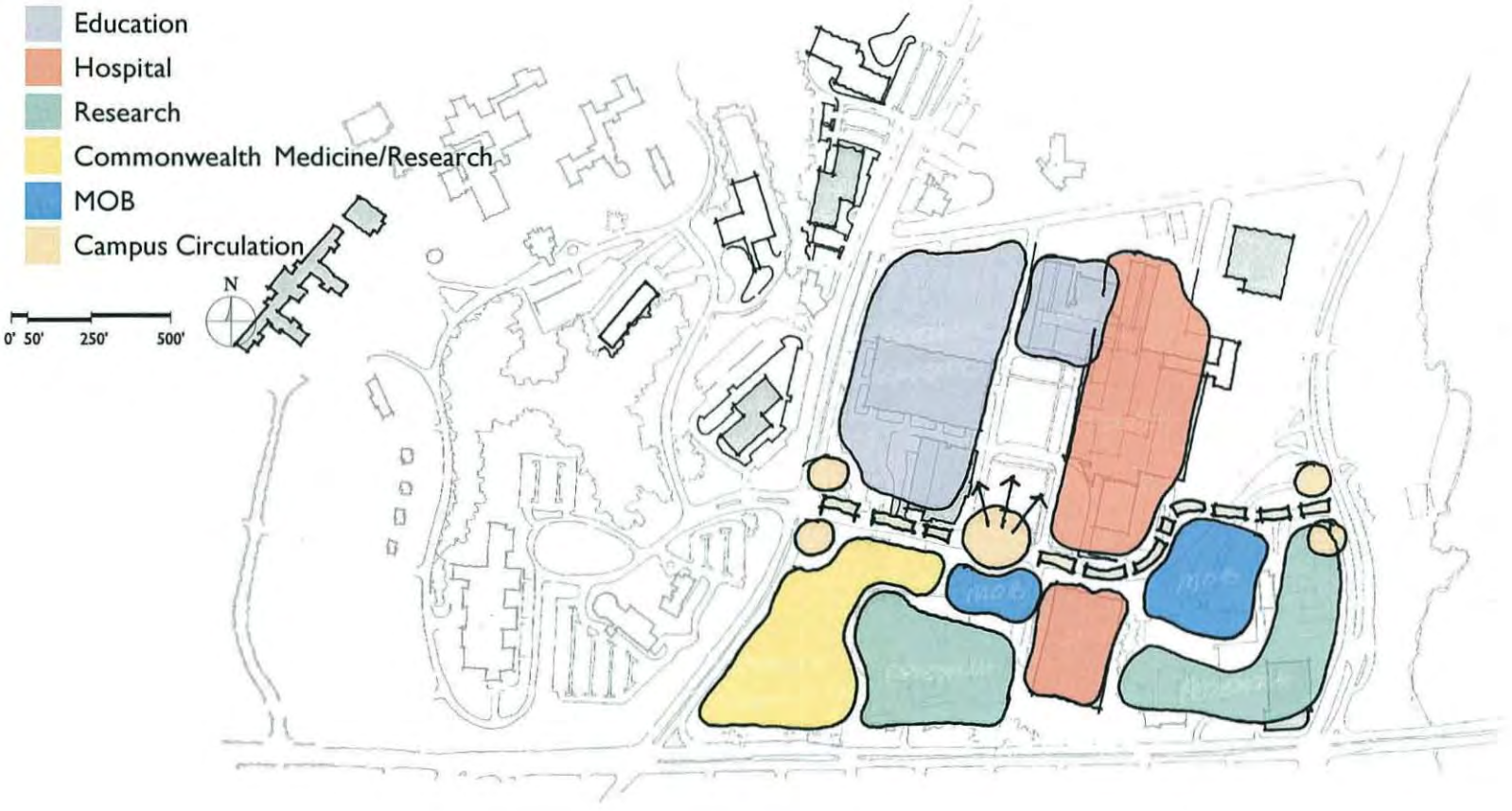
Total Parking 3,597 Cars



Option 3 - Green Buffer

Figure III.10

Use Diagram



Option 3 - Green Buffer

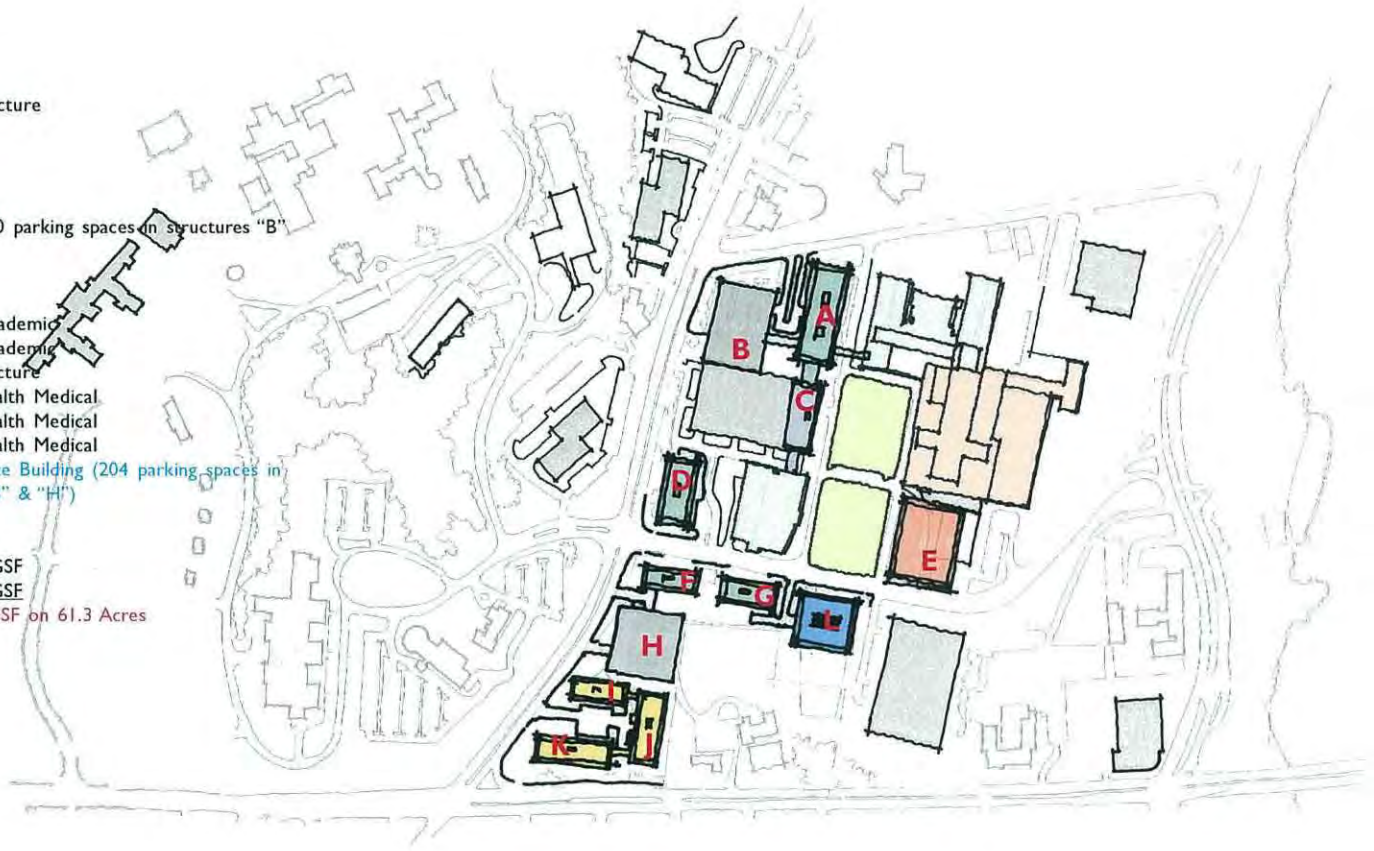
Phase I

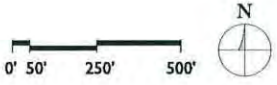
Figure III.11

Option 3 Phase I - 12 Buildings

Northwest Site		
Building A	168,000 GSF on 4 levels	Research
Building B	1,200 spaces on 8 levels	Parking Structure
Building C	96,000 GSF on 4 levels	Academic
Building D	96,000 GSF on 4 levels	Research
Northeast Site		
Building E	288,000 GSF on 4 levels	Hospital (490 parking spaces in structures "B" & "H")
Southwest Site		
Building F	60,000 GSF on 3 levels	Research/Academic
Building G	60,000 GSF on 3 levels	Research/Academic
Building H	1312 spaces on 8.75 levels	Parking Structure
Building I	36,000 GSF on 2 levels	Commonwealth Medical
Building J	50,000 GSF on 2 levels	Commonwealth Medical
Building K	50,000 GSF on 2 levels	Commonwealth Medical
Building L	120,000 GSF on 4 levels	Medical Office Building (204 parking spaces in structures "B" & "H")

Parking	2,512 Cars	
Total Phase I Building		1,024,000 GSF
Total Existing		2,341,000 GSF
Total Build Out-Phase I		3,365,000 GSF on 61.3 Acres
FAR 1.26		





Option 3 - Green Buffer
Phase 2

Figure III.12

Option 3 Phase 2 - 12 Buildings

Southwest Site

Building M	90,000 GSF on 3 levels	Research
Building N	75,000 GSF on 3 levels	Research
Building O	75,000 GSF on 3 levels	Research
Building P	720 cars on 8 levels	Parking Structure

Northeast Site

Building Q	60,000 GSF on 4 levels	Hospital (102 parking spaces in structure "X")

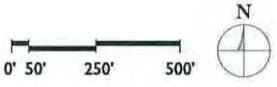
Southeast Site

Building R	81,000 GSF on 3 levels	Medical Office Building
Building S	108,000 GSF on 3 levels	Research
Building T	63,000 GSF on 3 levels	Research
Building U	84,000 GSF on 3 levels	Medical Office Building
Building V	66,000 GSF on 3 levels	Research
Building W	99,000 GSF on 3 levels	Research
Building X	1,503 cars on 7 levels	Parking Structure

Total Phase 2

Building	801,000 GSF
Parking	2,223 Cars

Total Parking	4,735 Cars
Total Phases 1& 2 Building	1,825,000 GSF
Total Existing	2,341,000 GSF
Total Build Out	4,166,000 GSF on 67.4 Acres
FAR 1.42	

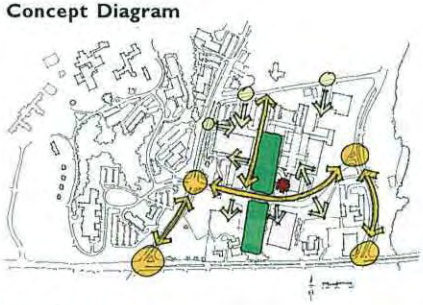


Option 1 - Capacity

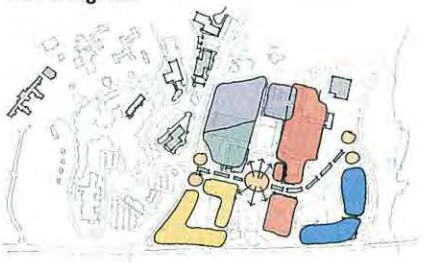
Campus Quad Concept

Figure III.13

Concept Diagram



Use Diagram



Option 1

Phase 1	
Medical Office Building	120,000 GSF
Ambulatory	186,000 GSF
Hospital	150,000 GSF
Academic	75,000 GSF
Research	241,000 GSF
Office	195,000 GSF
Total	**967,000 GSF**
Phase 2	
Medical Office Building	110,000 GSF
Office	178,500 GSF
Proposed	**1,255,500 GSF**
Existing	2,341,000 GSF
Total	**3,596,500 GSF**
	on 67.4 Acres
	FAR 1.22

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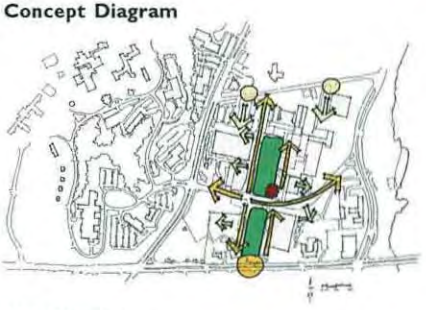
Option 2 - Capacity

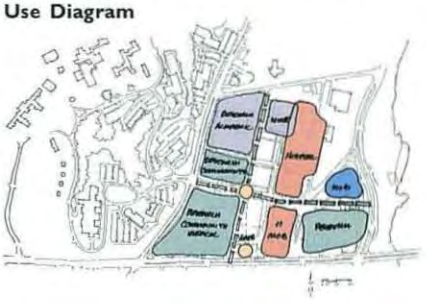
Auto Court Concept

Figure III.14

Concept Diagram



Use Diagram



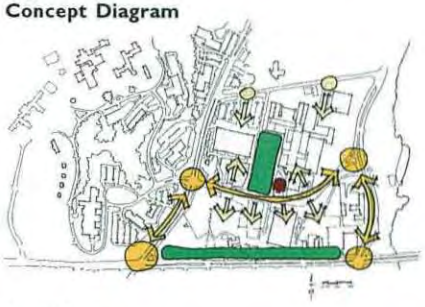
Option 2

Phase I	
Medical Office Building	120,000 GSF
Ambulatory	275,000 GSF
Hospital	108,000 GSF
Academic	75,000 GSF
Research	260,000 GSF
Office	81,000 GSF
Total	**919,000 GSF**
Phase 2	
Office	500,000 GSF
Proposed	**1,419,000 GSF**
Existing	2,341,000 GSF
Total	**3,760,000 GSF**
	on 67.4 Acres
	FAR 1.28

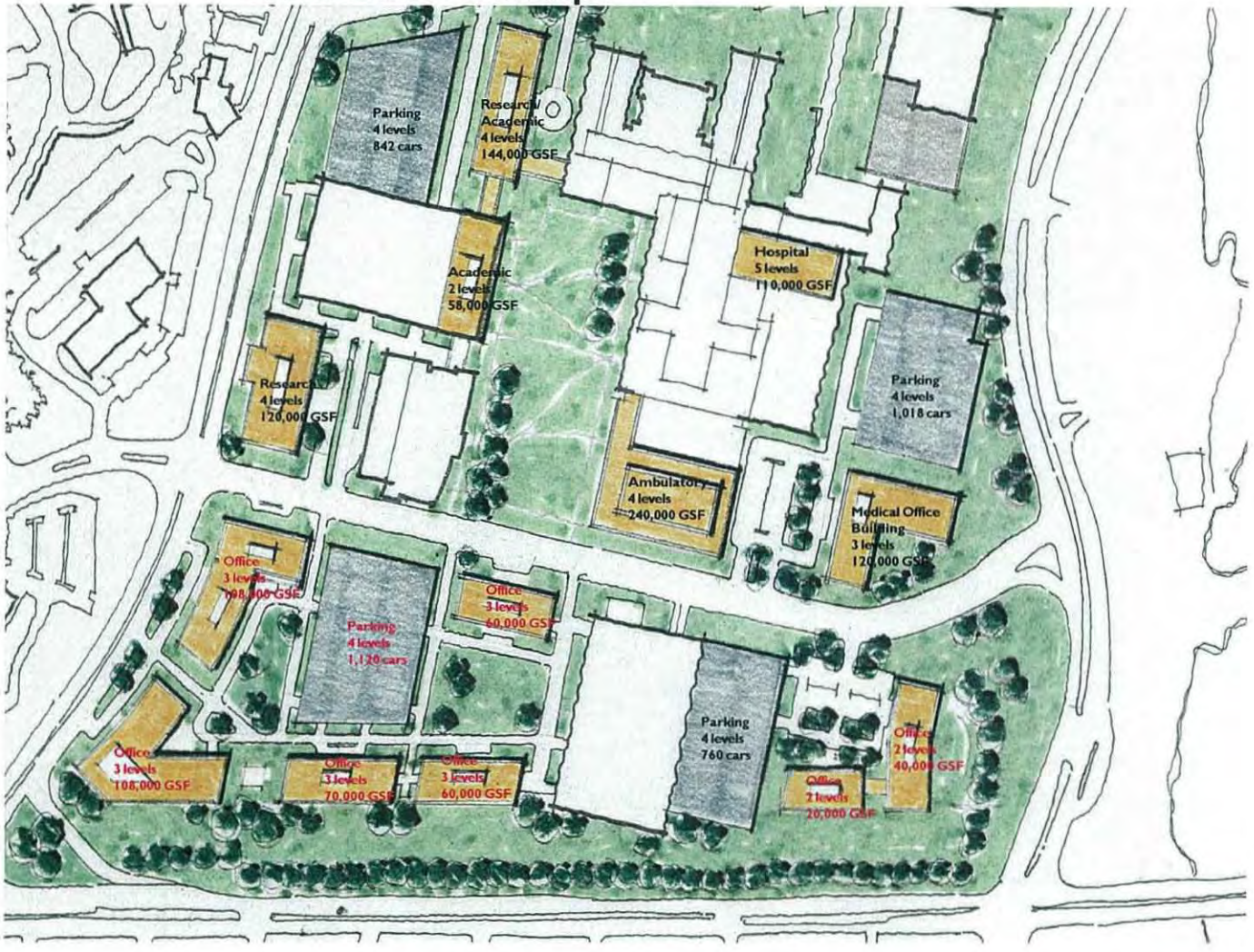
Option 3 - Capacity
Green Buffer Concept

Figure III.15

Concept Diagram



Use Diagram



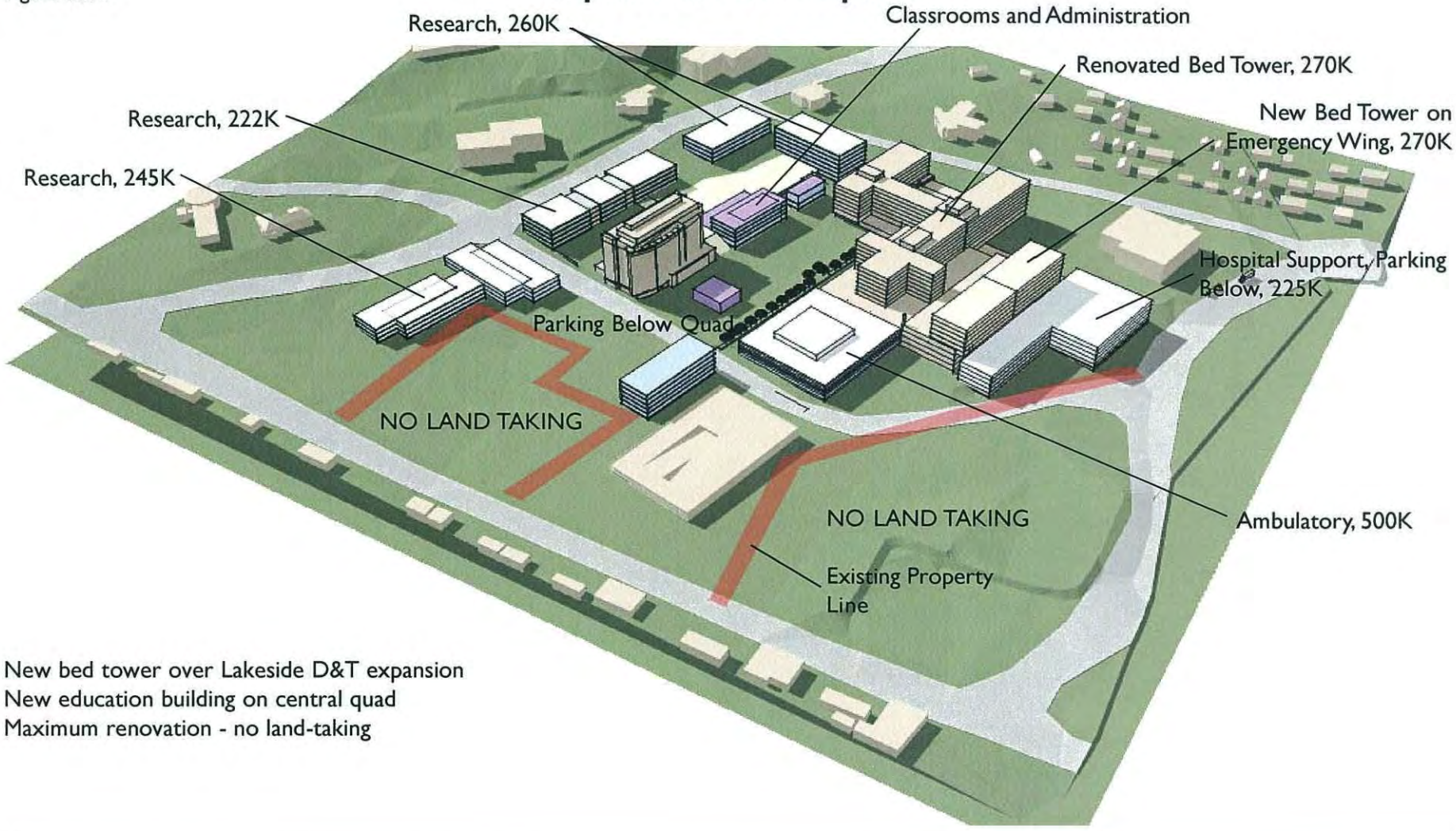
Option 3

Phase 1	
Medical Office Building	120,000 GSF
Ambulatory	240,000 GSF
Hospital	110,000 GSF
Academic	75,000 GSF
Research	241,000 GSF
Office	0 GSF
Total	**786,000 GSF**
Phase 2	
Office	406,000 GSF
Proposed	**1,192,000 GSF**
Existing	2,341,000 GSF
Total	**3,533,000 GSF**
	on 67.4 Acres
	FAR 1.20

Density Study

Option 1a - Low Impact

Figure III.16

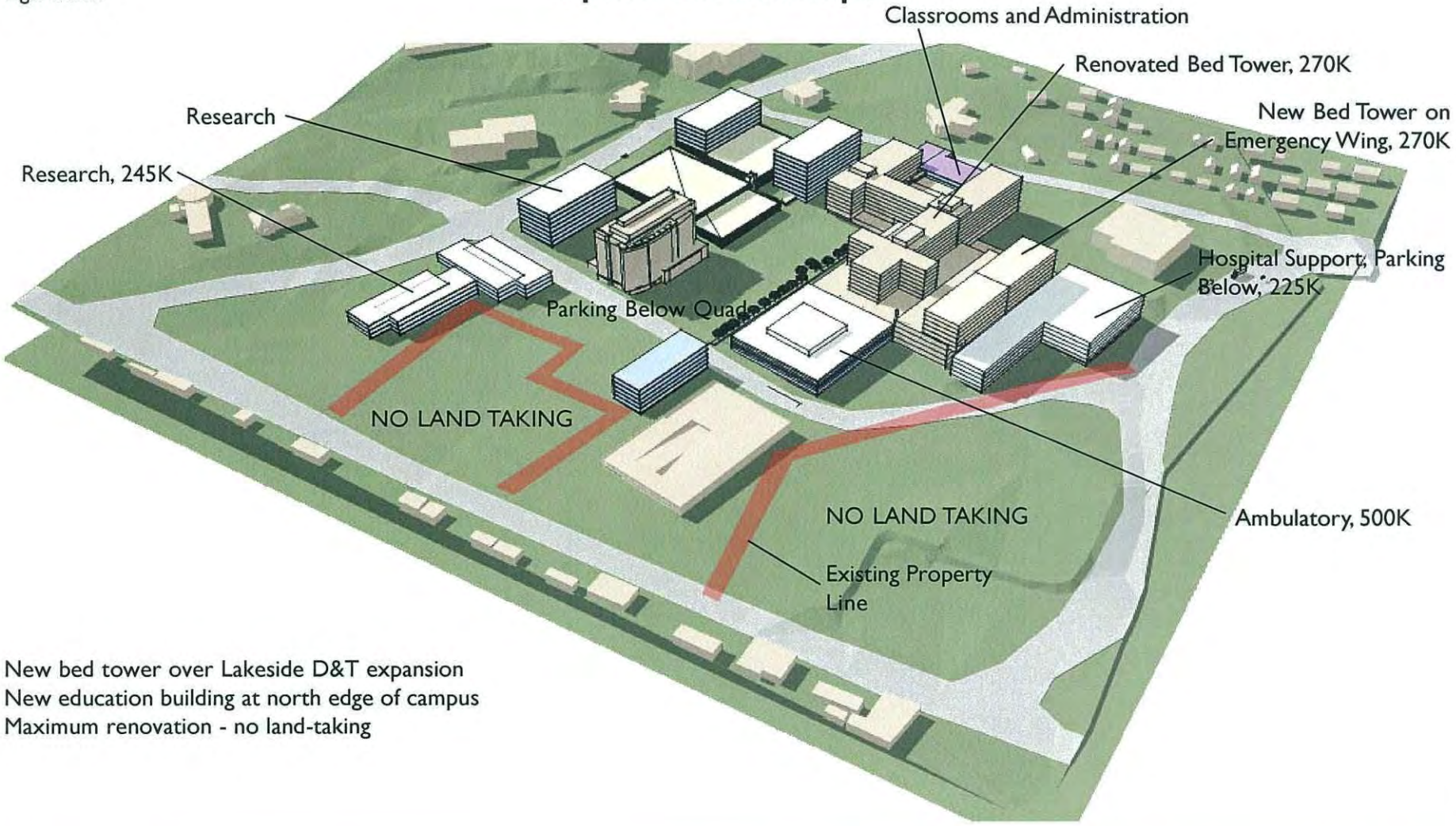


New bed tower over Lakeside D&T expansion
New education building on central quad
Maximum renovation - no land-taking

Density Study

Option 1b - Low Impact

Figure III.17

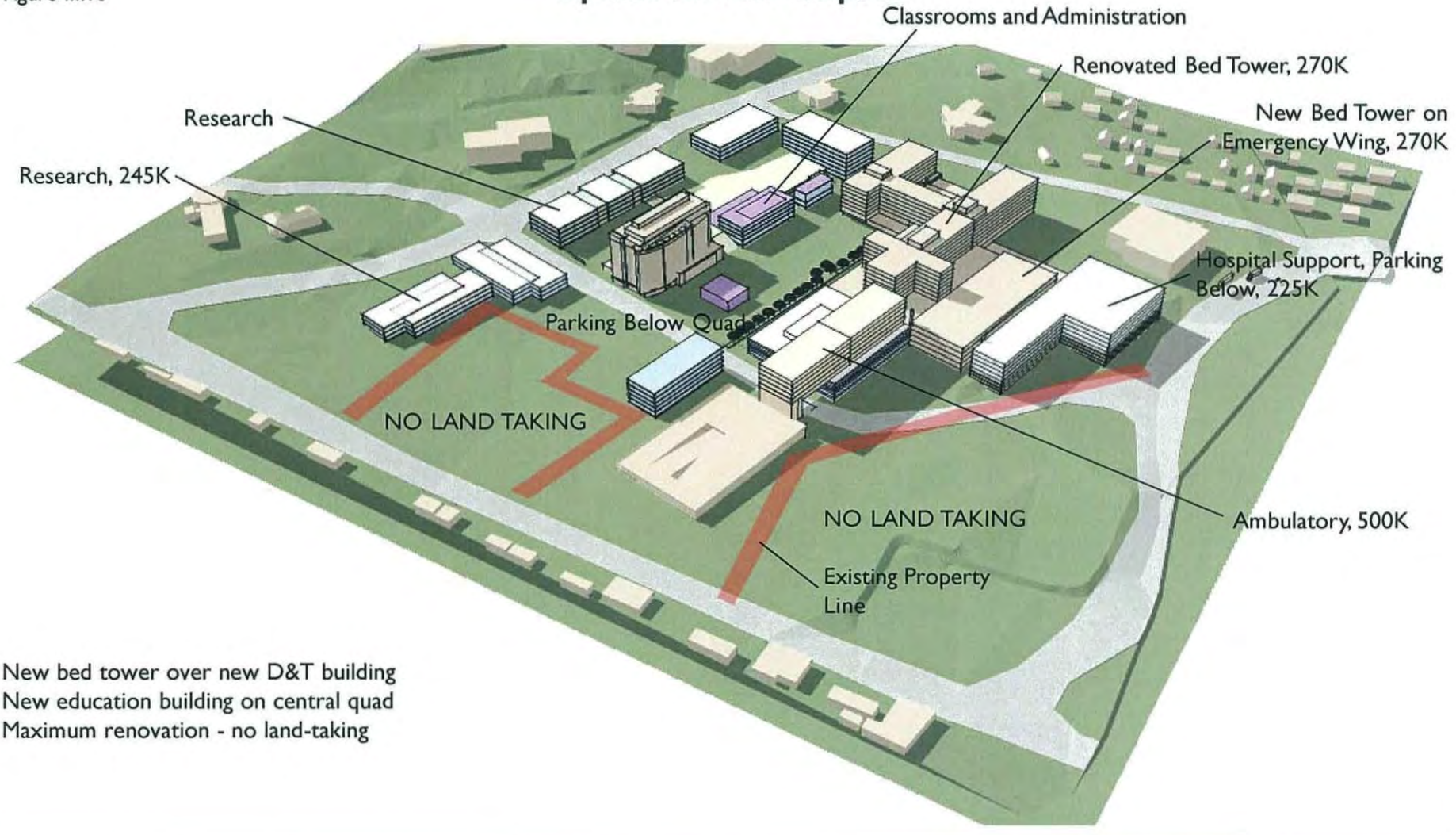


New bed tower over Lakeside D&T expansion
New education building at north edge of campus
Maximum renovation - no land-taking

Density Study

Option 1c - Low Impact

Figure III.18

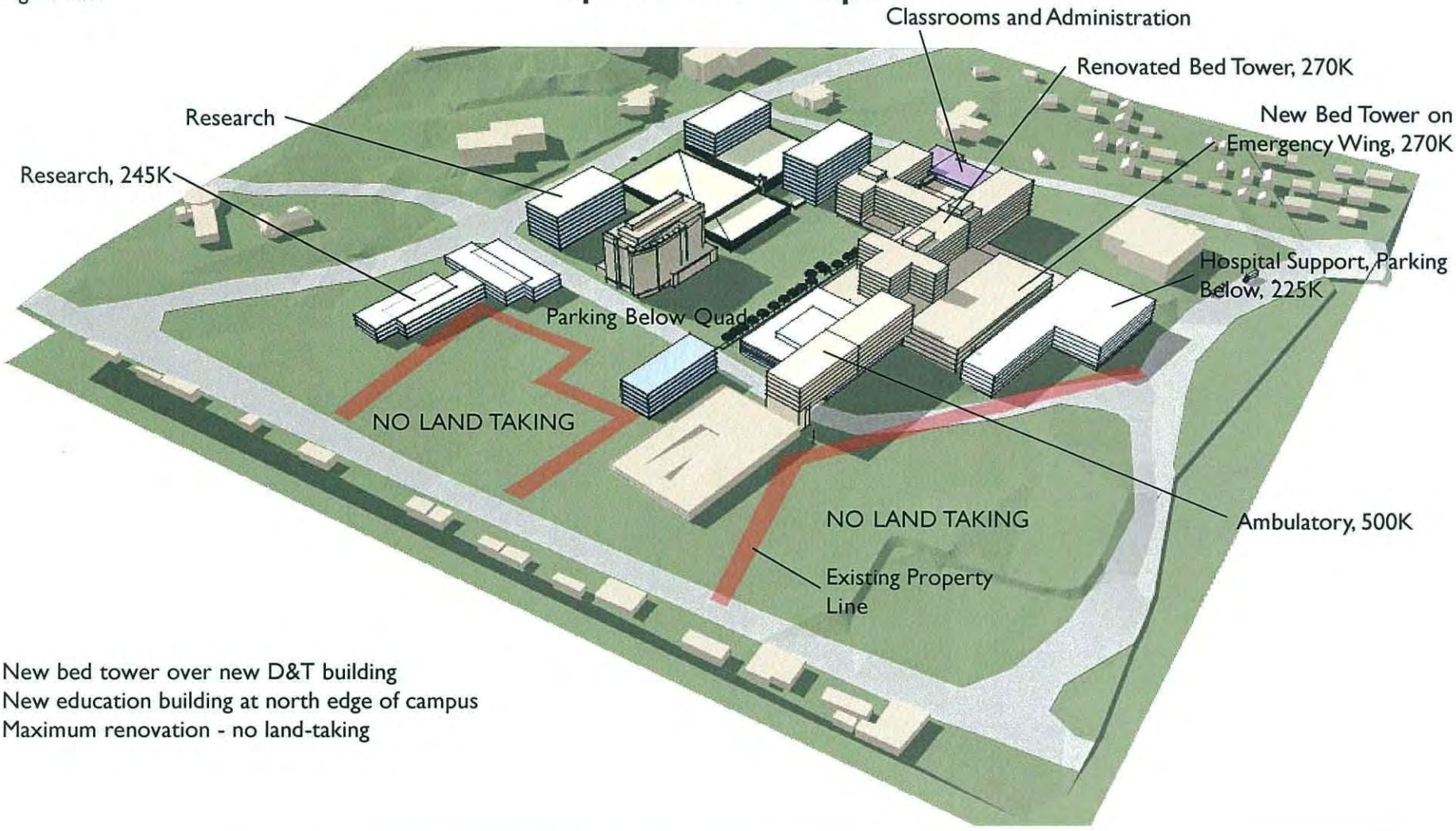


New bed tower over new D&T building
New education building on central quad
Maximum renovation - no land-taking

Density Study

Option 1d - Low Impact

Figure III.19

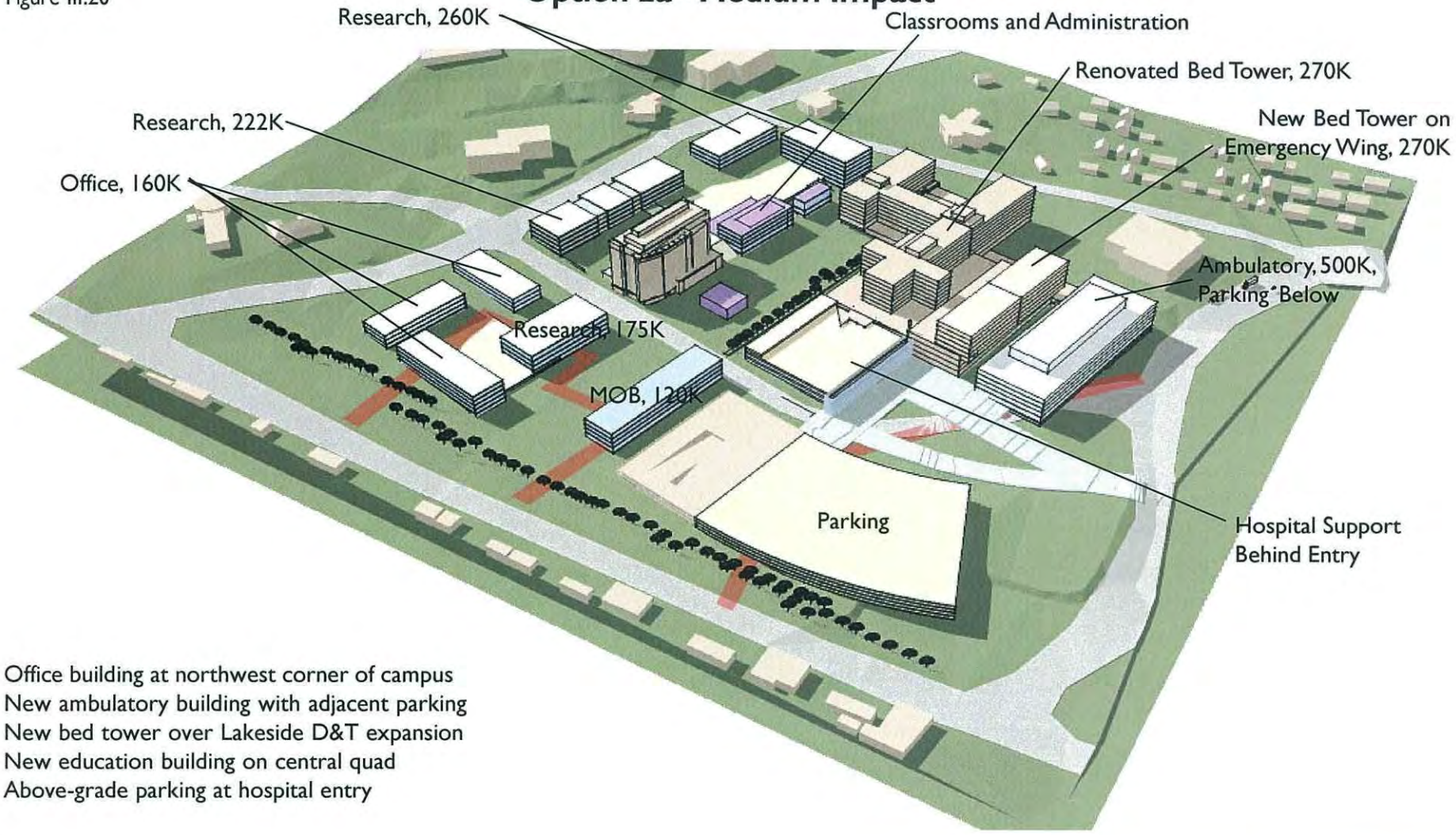


New bed tower over new D&T building
New education building at north edge of campus
Maximum renovation - no land-taking

Density Study

Option 2a - Medium Impact

Figure III.20

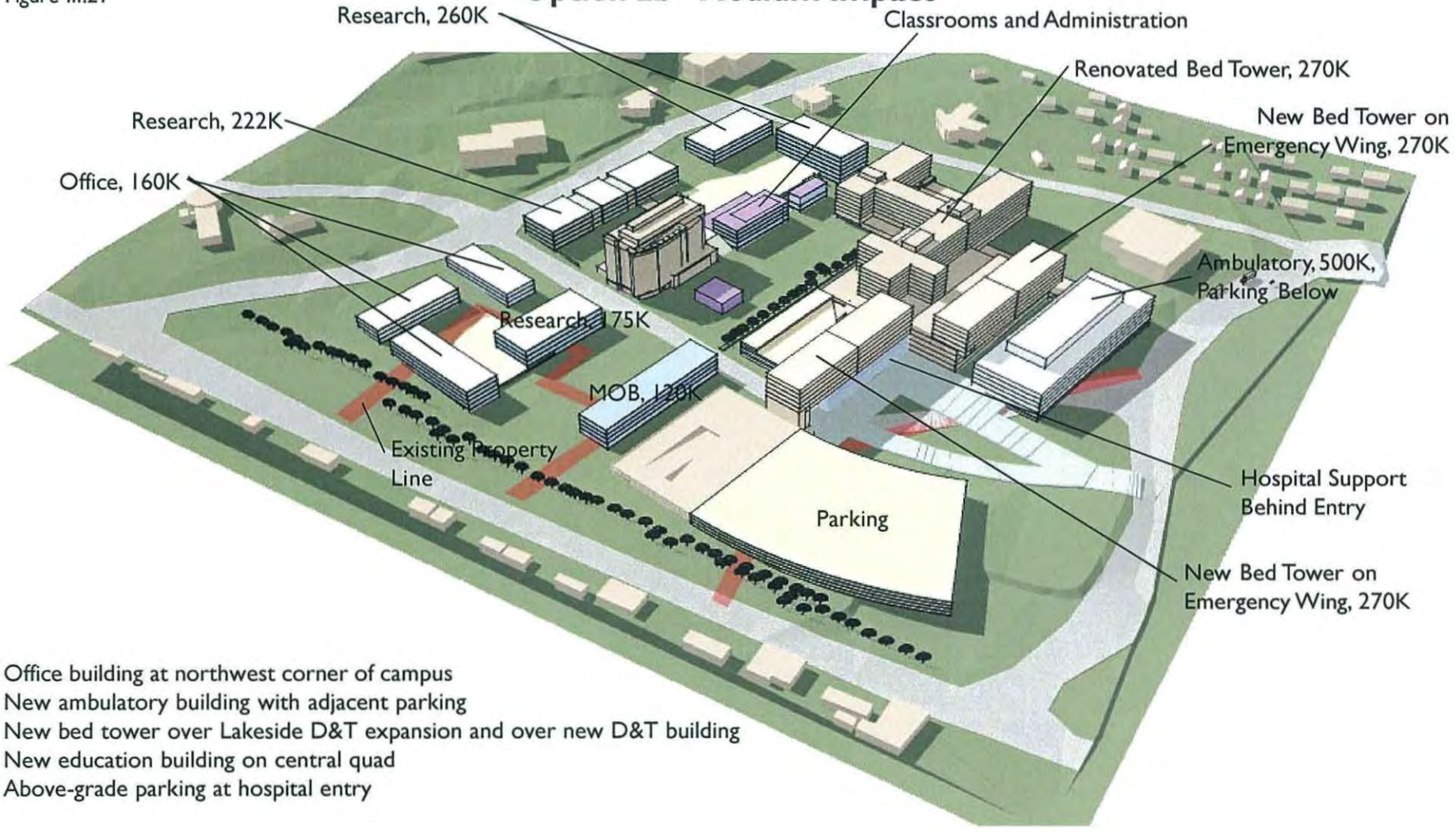


Office building at northwest corner of campus
New ambulatory building with adjacent parking
New bed tower over Lakeside D&T expansion
New education building on central quad
Above-grade parking at hospital entry

Density Study

Option 2b - Medium Impact

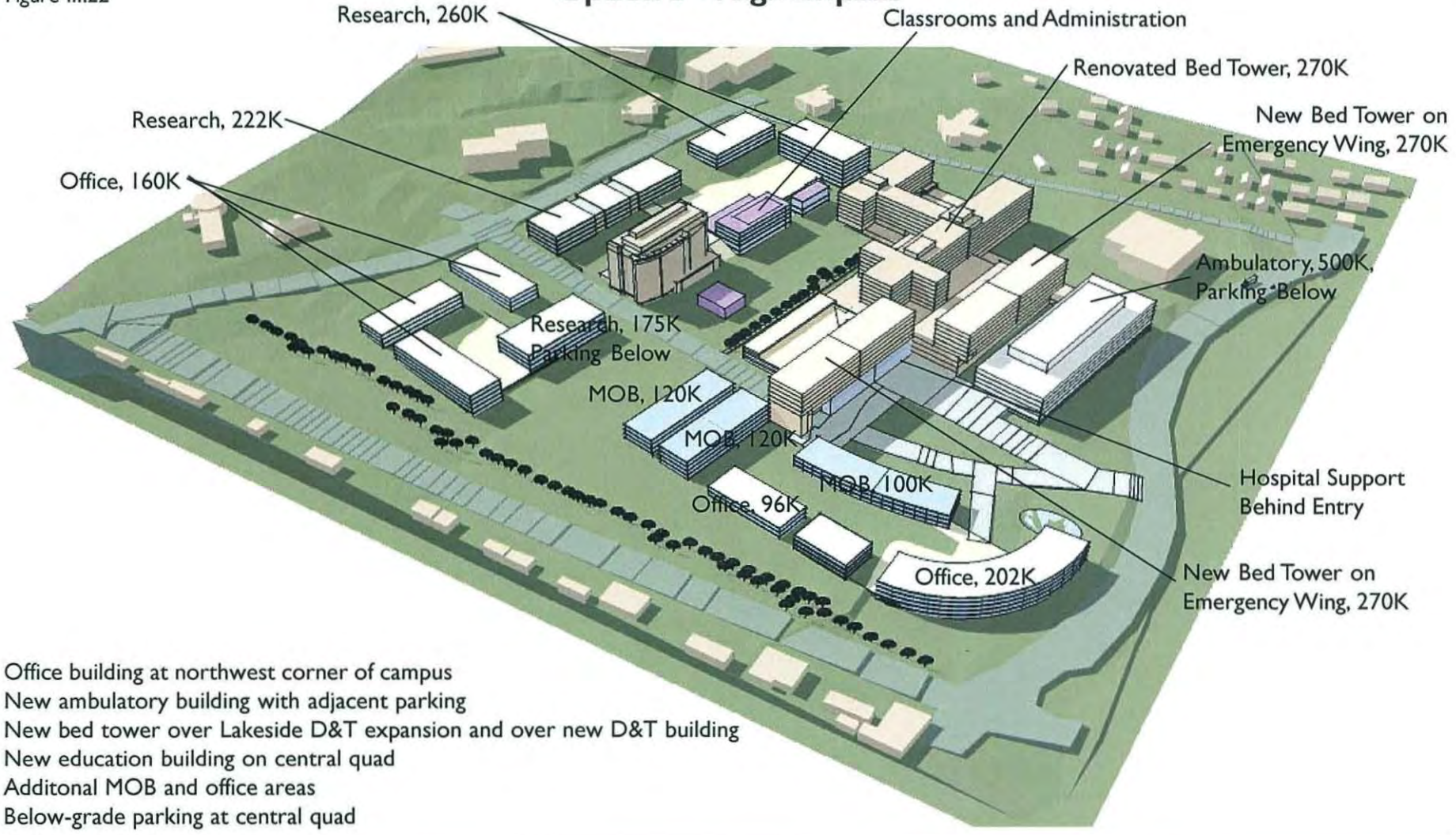
Figure III.21



Office building at northwest corner of campus
New ambulatory building with adjacent parking
New bed tower over Lakeside D&T expansion and over new D&T building
New education building on central quad
Above-grade parking at hospital entry

Density Study
Option 3 - High Impact

Figure III.22

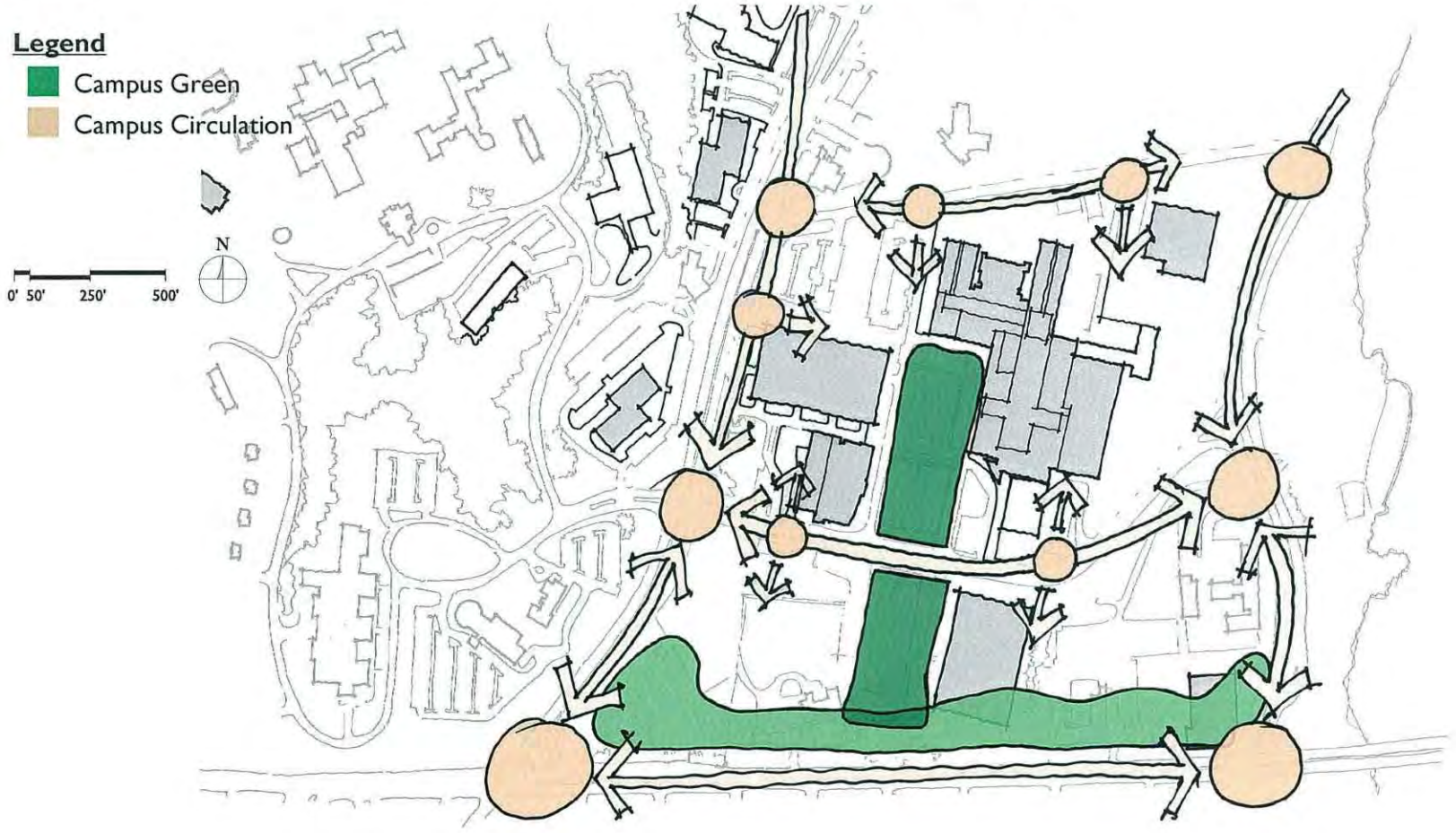


Office building at northwest corner of campus
New ambulatory building with adjacent parking
New bed tower over Lakeside D&T expansion and over new D&T building
New education building on central quad
Additonal MOB and office areas
Below-grade parking at central quad

Campus Quads and Green Buffer

Preferred Campus Concept

Figure III.23



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ARCHITECTS

University of Massachusetts Medical School

Section IV. Proposed Campus Plan

PROPOSED CAMPUS PLAN

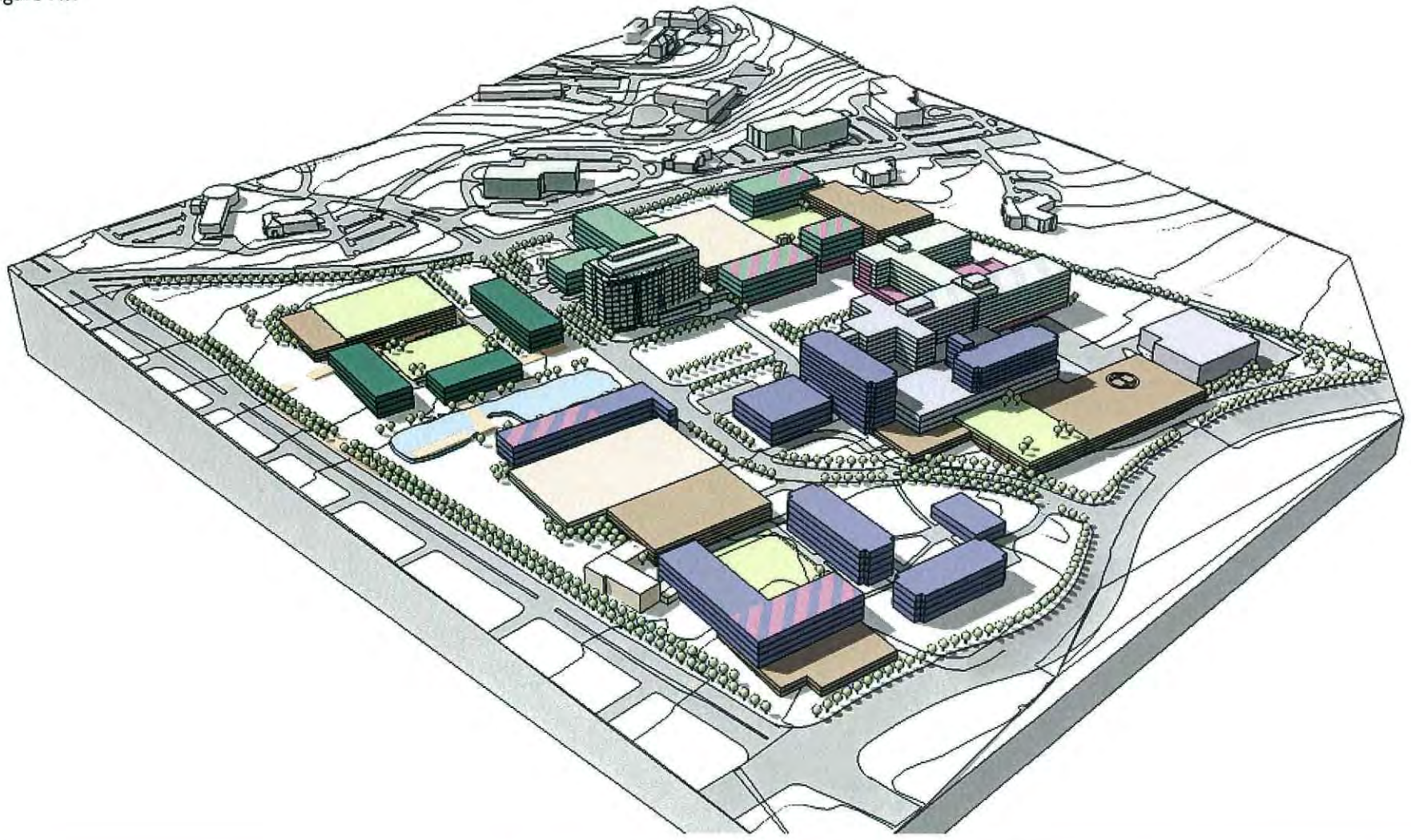
The master plan of the University of Massachusetts Medical School design intends to achieve the following.

- A unified identity for the academic medical center campus
- A compelling campus image and identity from Route 9
- Clear points of campus entry - off Lake Avenue and Plantation Street
- A strong campus center, accessible to all
- A unified, humanly-scaled collection of campus spaces that accommodates the future growth needs of the institution
- Adequate structured parking that is easily accessible to the different needs of the campus
- Intuitive wayfinding
- A clear "Front Door" to each important component of the campus
- A number of interlocking pedestrian-friendly environments of varying scales
- Creation of a "there" there

The following pages show the proposed master plan in its final phase, fully built out. Plan, axon and computer-generated perspective views are provided.

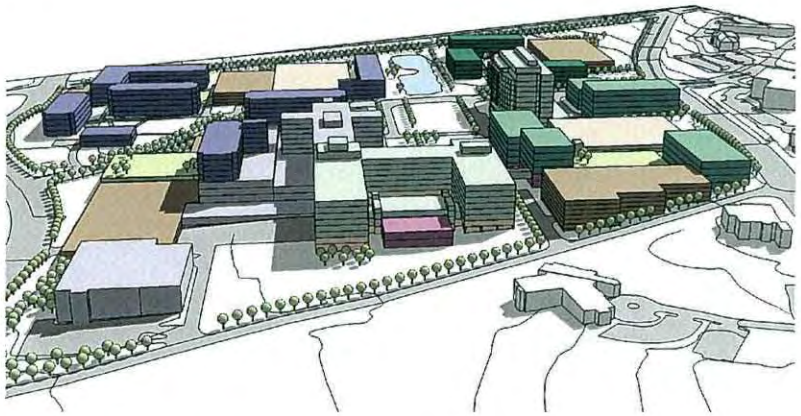
Design Axonometric

Figure IV.1



Design Vignettes

Figure IV.2



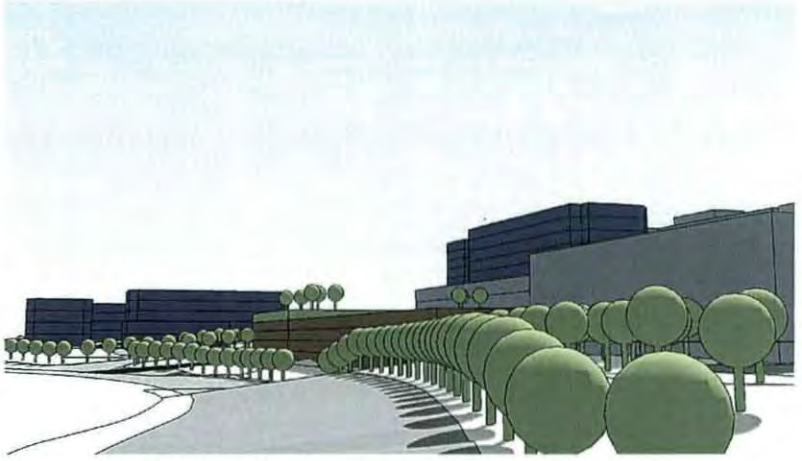
Aerial looking south

Aerial looking northwest

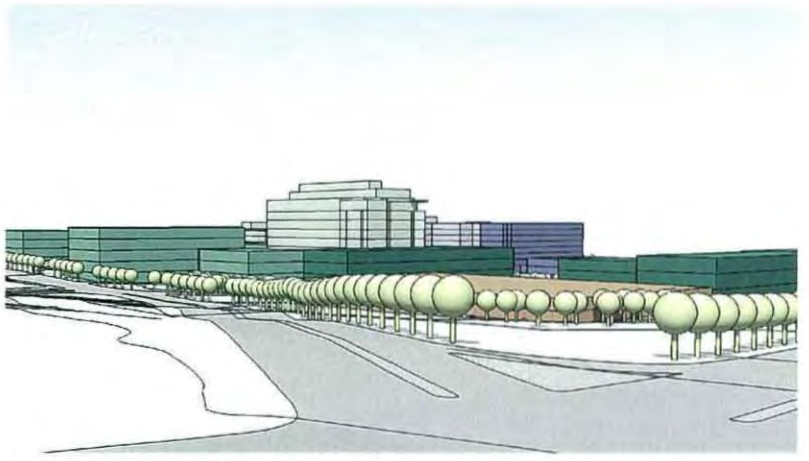
View from Belmont Street

Design Vignettes

Figure IV.3

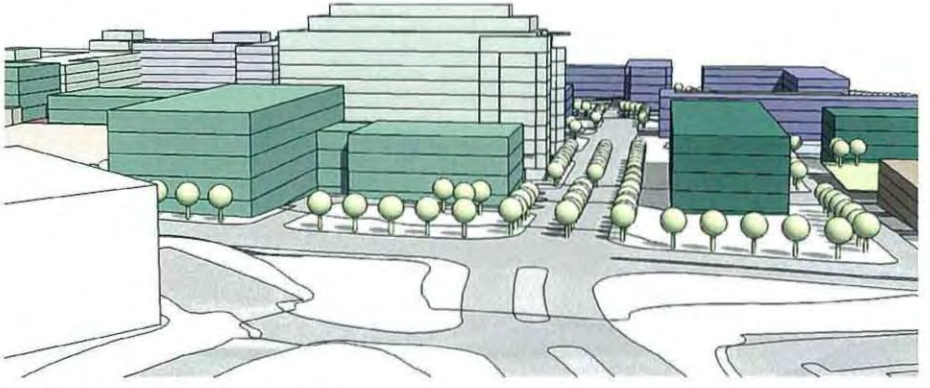


Looking south from Lake Avenue



Looking northeast from Belmont Street

Looking south from Plantation Street

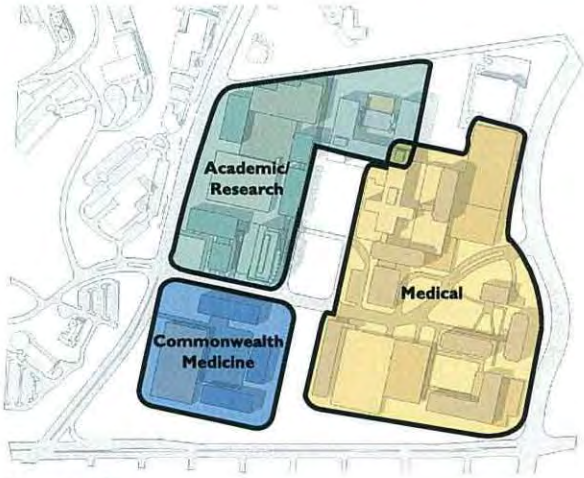


Looking east from South Road

Organizing Principles of Proposed Campus Plan

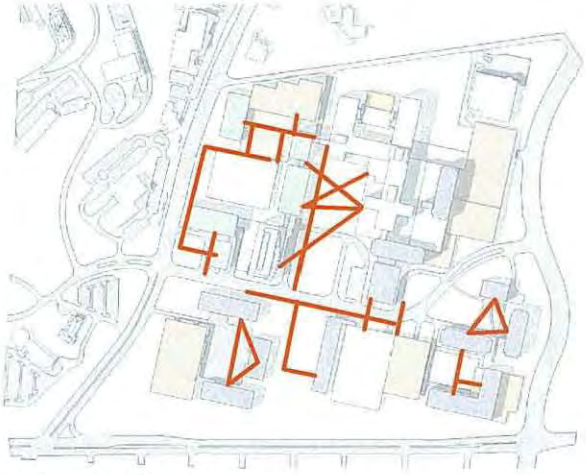
Figure IV.4

Campus Greens



Campus Uses

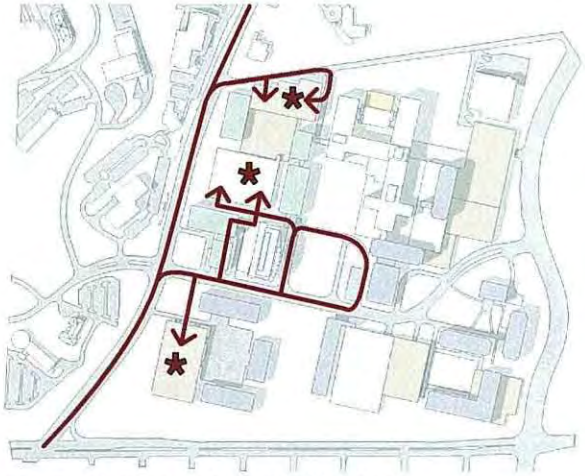
Service Dock Locations



Pedestrian Circulation

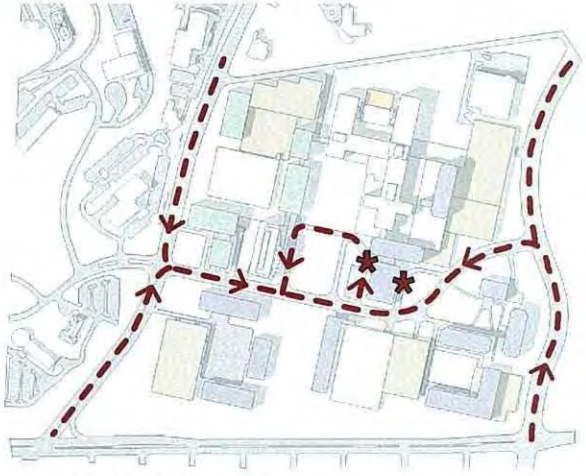
Organizing Principles of Proposed Campus Plan

Figure IV.5



Academic/Research Auto Circulation

Major Building Entries



Hospital Auto Circulation

Parking Structures

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Section V. Campus Phasing Plan

CAMPUS PHASING PLAN

Phase One
Entails a planning horizon of approximately 5-10 years. The most pressing needs for the near term were identified as:

- Build 120,000-140,000 GSF Advanced Clinical Education and Practice Center (ACE&PC)
- Traffic Mitigation Along Lake Avenue
  - Acquire Army Reserve Property
  - Road Reconstruction
- Build Ambulatory, Bed Tower and D&T Center
  - Acquire Mass Highway Property
  - Build Additional Power Plant at South End of Campus
  - Build Additional Parking Structure 1
  - Build Additional Parking Structure 2
  - Build Ambulatory Buildings
  - Demolish Benedict Building
  - Build Bed Tower and D&T Center
- Build Academic/Research Capacity
  - Demolish East Section of West Garage
  - Build Academic/Research Building

Phase Two
Entails a planning horizon of approximately 10-15 years. Likely needs at this stage were identified as:

- Build Second Bed Tower (150 Beds)
  - Acquire Department of Youth Services Property
  - Build Retention Pond
  - Build Hospital Structure with Helipad
  - Build Second Bed Tower
- Build Academic/Research Building
  - Build Parking Structure at Northwest Corner of Campus
  - Build Academic/Research Building
- Build Academic/Research Building

Phase Three
Entails a planning horizon beyond 15 years.

- Mixed Use and ACE&PC

Note: Unassigned research space in the Aaron Lazare Medical Research Building provides flexibility to convert wet lab space in the original education building to dry research as part of Phase 1 or 2 as necessary.

Existing Conditions

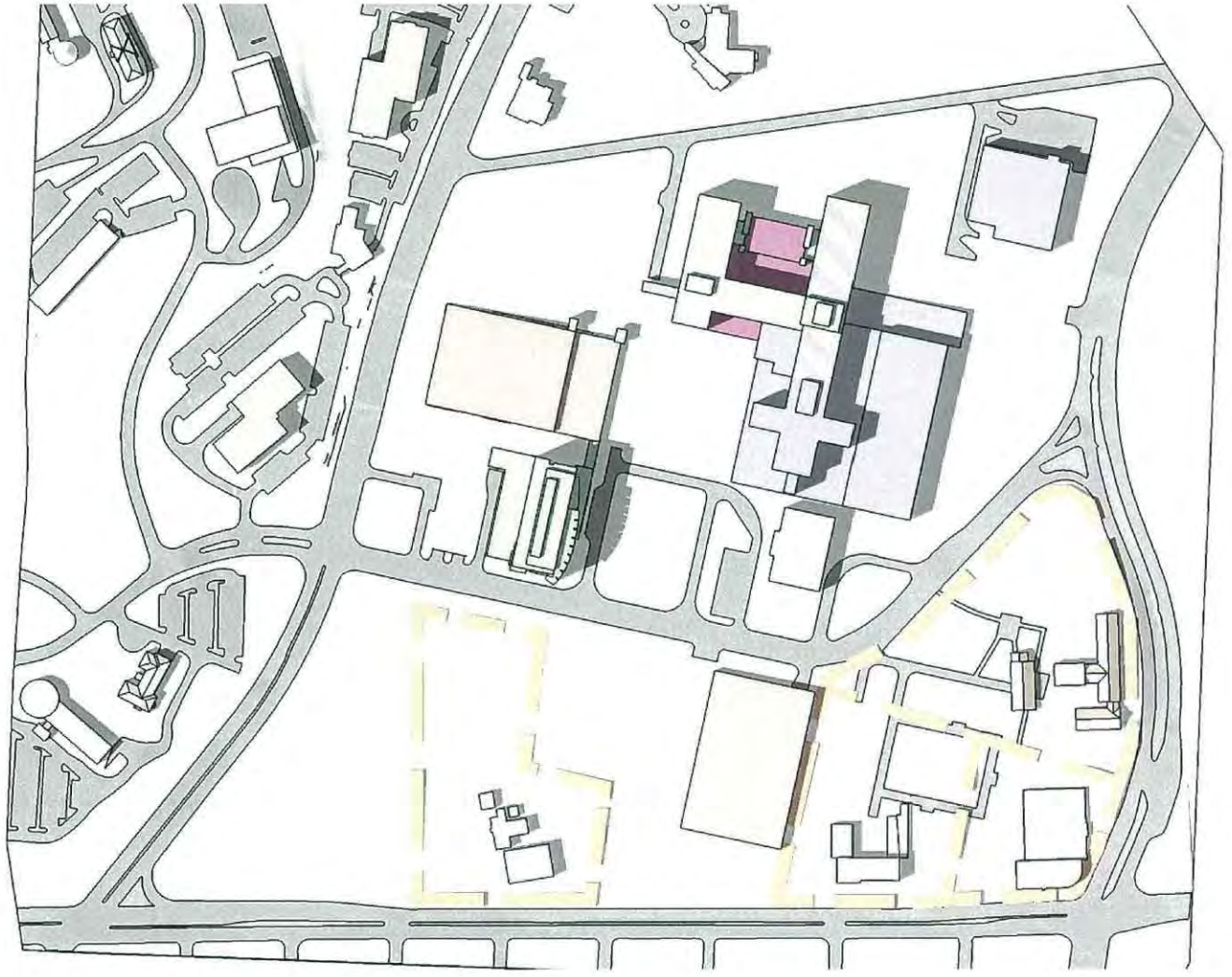
Figure V.1

Legend

- Existing Research
- Existing Hospital
- Existing Parking
- Existing Education
- Off Campus Boundaries

0' 50' 250' 500'

N



Phase 1.1 - Build Advanced Clinical Education & Practice Center

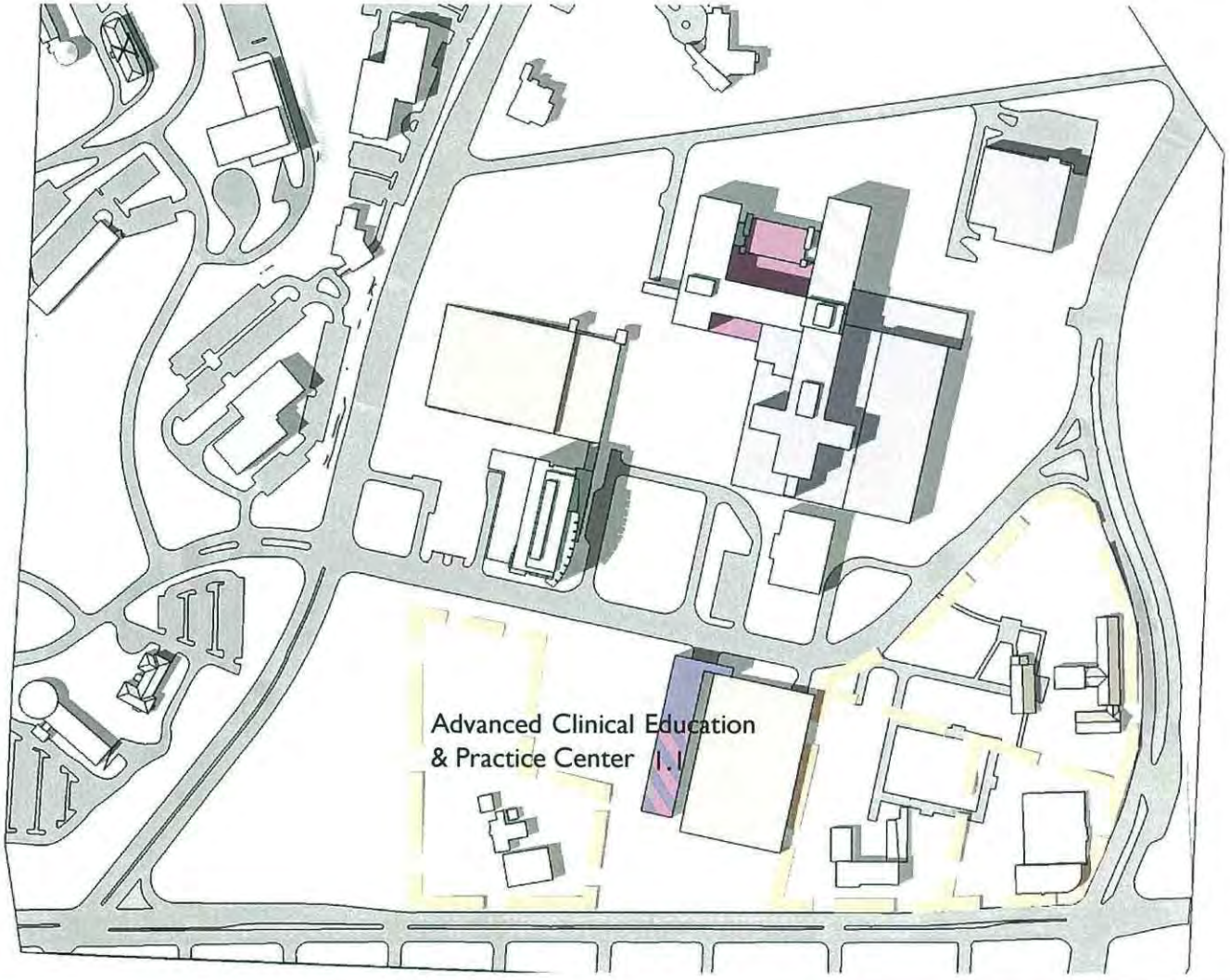
Figure V.2

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N



Phase 1.2 - Traffic Mitigation Along Lake Avenue

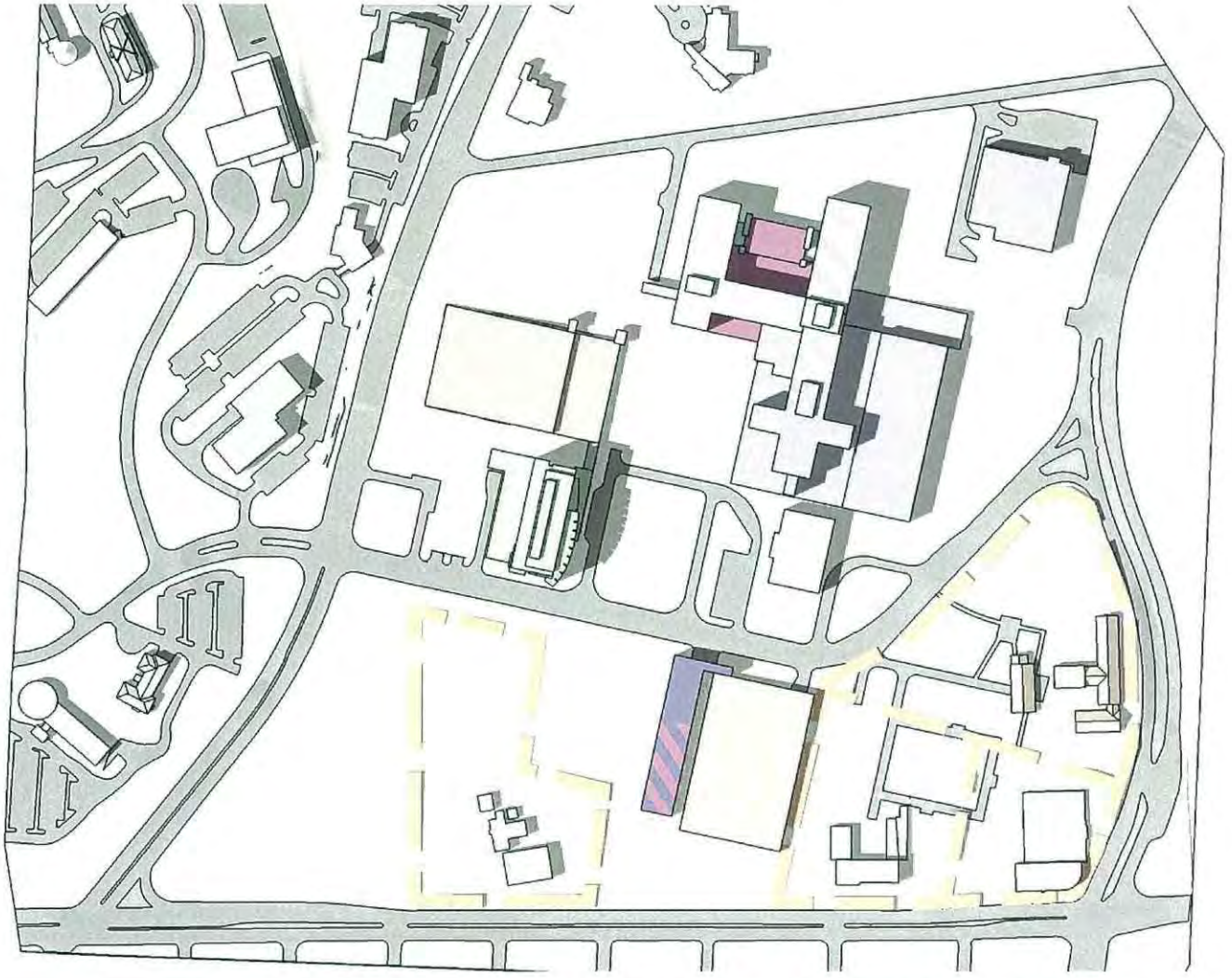
Figure V.3

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N



Phase 1.2a - Traffic Mitigation: Acquire Army Reserve Property

Figure V.4

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N

Phase 1.2b - Traffic Mitigation: Road Reconstruction

Figure V.5

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N

Phase 1.3 - Build Ambulatory, Bed Tower and D&T Center

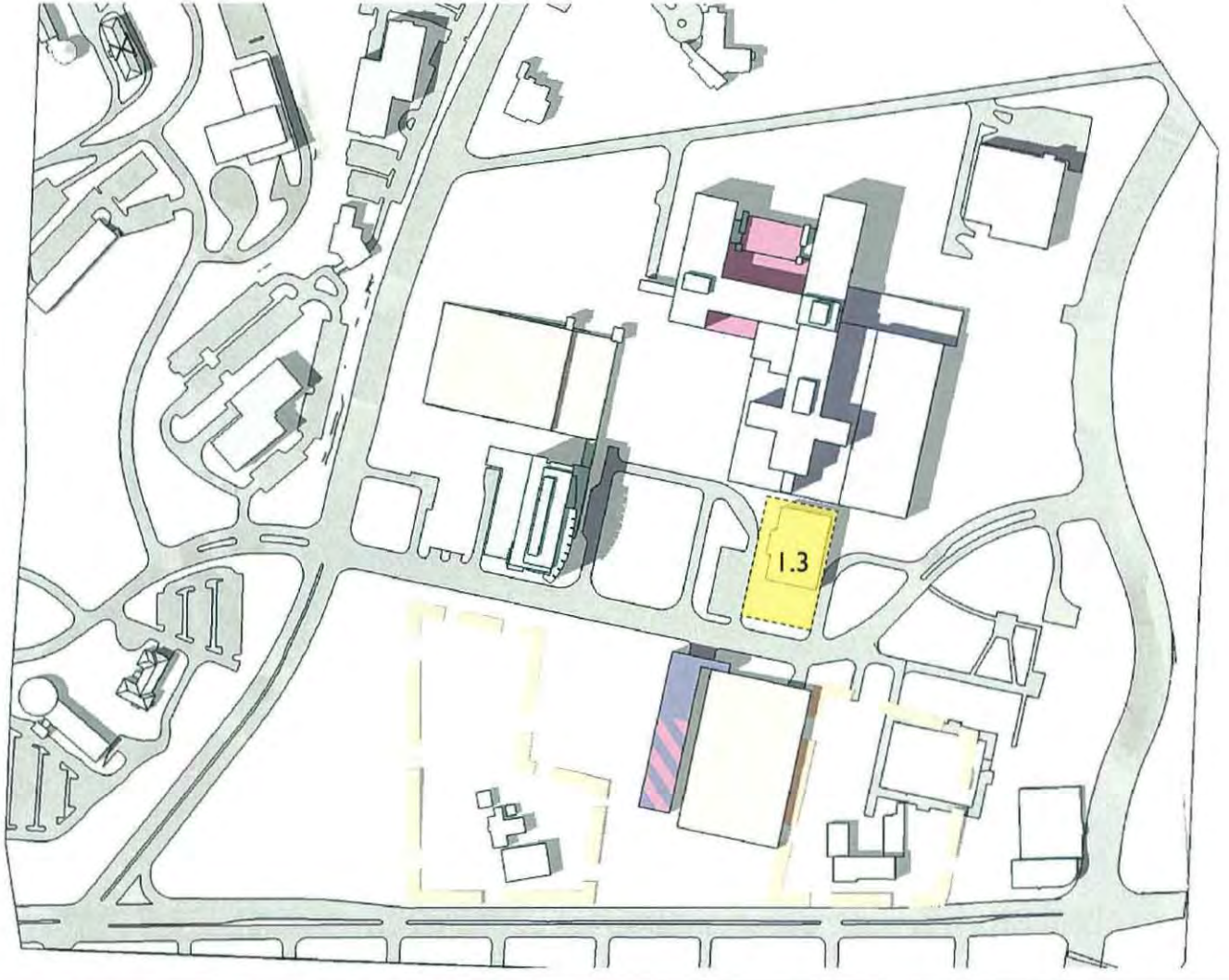
Figure V.6

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N



Phase 1.3a - Acquire MassHighway Property

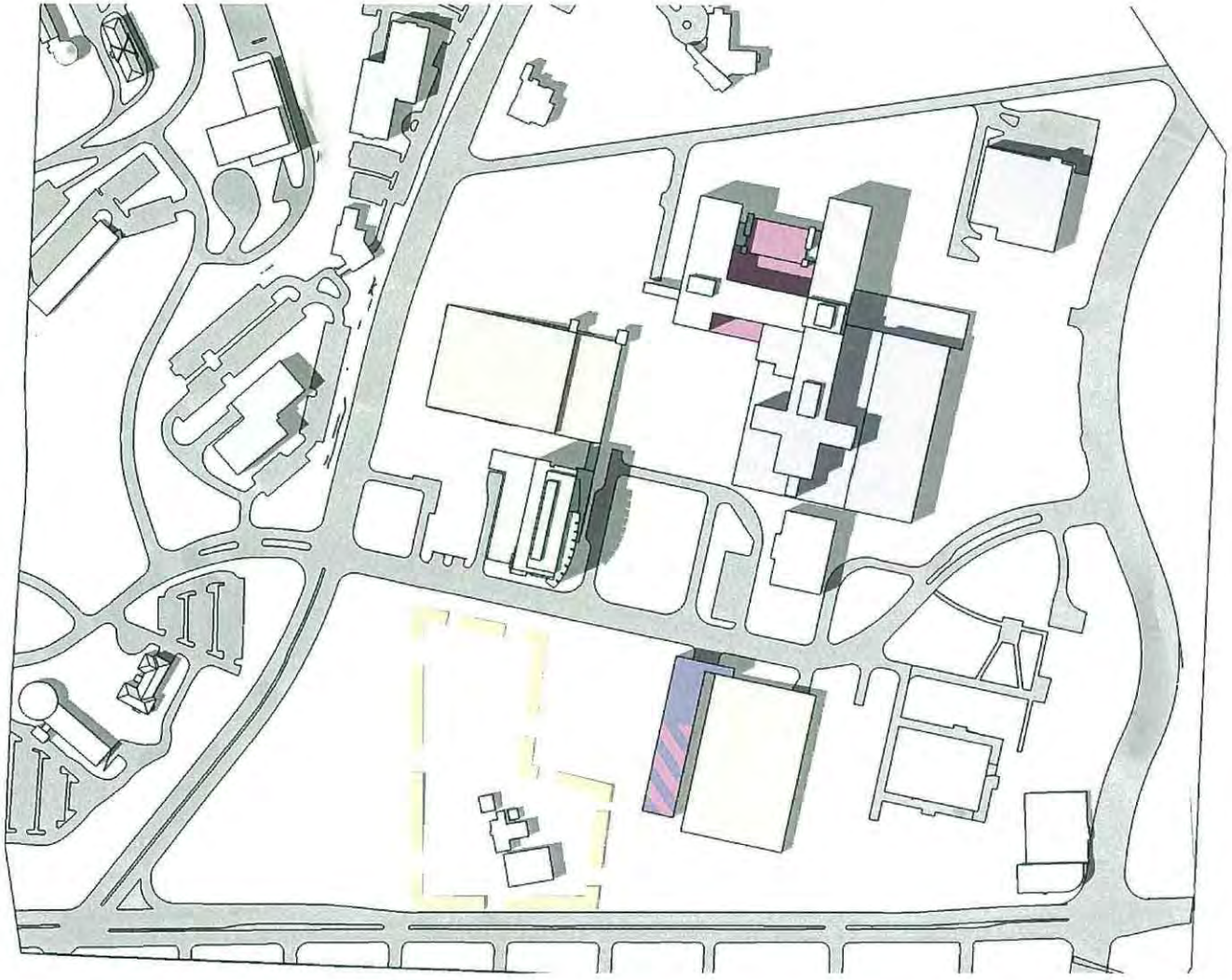
Figure V.7

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N



Phase 1.3b - Build Additional Power Plant at South End of Campus

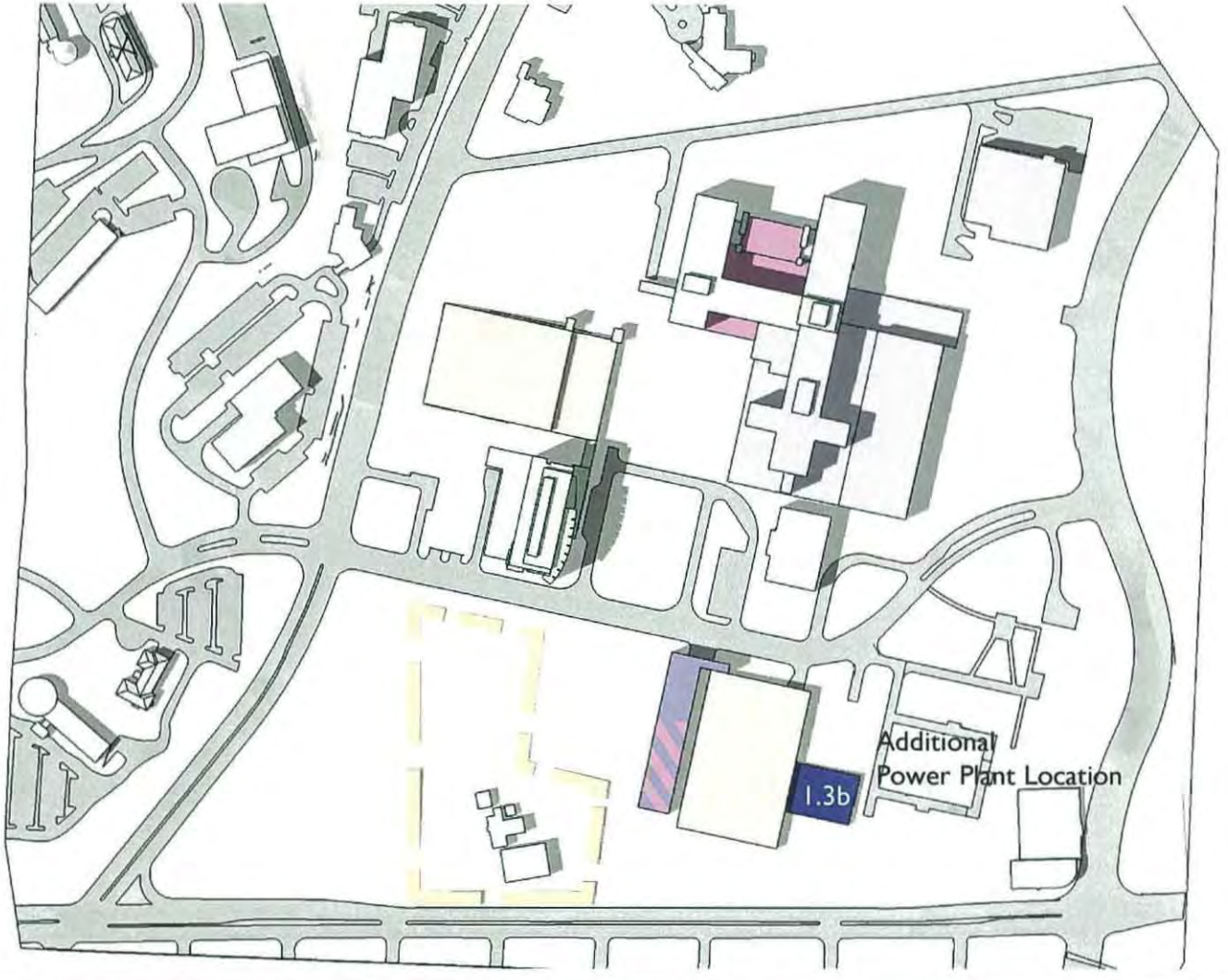
Figure V.8

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N



Phase 1.3c - Build Additional Parking Structure

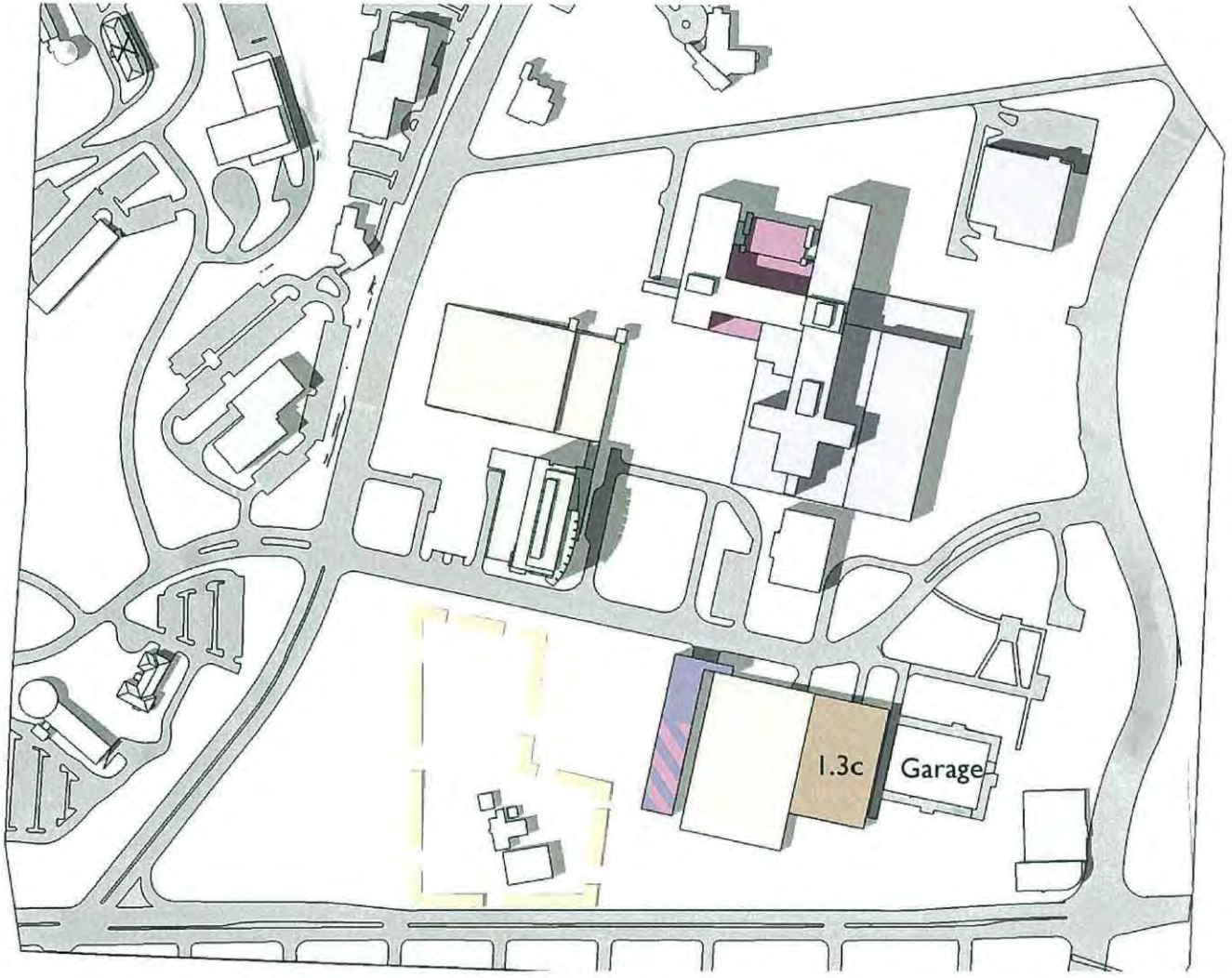
Figure V.9

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N



Phase 1.3d - Build Additional Parking Structure 2

Figure V.10

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N

Phase 1.3e - Build Ambulatory Buildings

Figure V.11

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N

Phase 1.3f - Demolish Benedict Building

Figure V.12

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N

Phase 1.3g - Build Bed Toweer and D&T Center

Figure V.13

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N

Phase 1.4 - Build Academic/Research Capacity

Figure V.14

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N

Phase 1.4a - Demolish East Section of West Garage

Figure V.15

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N

Phase 1.4b - Build Academic/Research Buildings

Figure V.16

Legend

- Existing Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries

0' 50' 250' 500'

N

Phase 2.5 - Build Second Bed Tower (150 Beds)

Figure V.17

Legend

- Existing Research
- New Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries
- Retention Pond

N

0' 50' 250' 500'

Phase 2.5a - Acquire Department of Youth Services Property

Figure V.18

Legend

- Existing Research
- New Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries
- Retention Pond

0' 50' 250' 500'

N

Phase 2.5b - Build Retention Pond

Figure V.19

Legend

- Existing Research
- New Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries
- Retention Pond

0' 50' 250' 500'

N

Phase 2.5c - Build Hospital Parking Structure with Helipad

Figure V.20

Legend

- Existing Research
- New Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries
- Retention Pond

0' 50' 250' 500'

N

Phase 2.5d - Build Second Bed Tower

Figure V.21

Legend

- Existing Research
- New Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries
- Retention Pond

0' 50' 250' 500'

N

Phase 2.6 - Build Academic/Research Building

Figure V.22

Legend

- Existing Research
- New Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries
- Retention Pond

0' 50' 250' 500'

N

Phase 2.6a - Build Parking Structure at Northwest Corner of Campus

Figure V.23

Legend

- Existing Research
- New Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries
- Retention Pond

N

0' 50' 250' 500'

Phase 2.6b - Build Academic/Research Building

Figure V.24

Legend

- Existing Research
- New Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries
- Retention Pond

0' 50' 250' 500'

N

Phase 2.7 - Build Academic/Research Building

Figure V.25

Legend

- Existing Research
- New Research
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries
- Retention Pond

0' 50' 250' 500'

N

Phase 3 - Mixed Use and Advanced Clinical Education & Practice Center

Figure V.26

Legend

- Existing Research
- New Research
- Office
- Existing Hospital
- New Hospital
- Existing Parking
- New Parking
- Existing Education
- New Education
- Green Space
- Off Campus Boundaries
- Retention Pond

0' 50' 250' 500'

N

TSOI / KOBUS & ASSOCIATES
ARCHITECTS

University of Massachusetts Medical School

Section VI. Proposed Landscape Plan

UMass Worcester Medical School and Hospital Landscape Master Plan

Program
Planning & Design Concepts
Design Guidelines

Denig Design Associates, Inc.
Landscape Architects
142 Main Street
Northampton, Massachusetts 01060

March, 2005

PROGRAM

GOALS

The Landscape Master Plan for the University of Massachusetts Medical School (UMMS) aims to envision site development complementary to the projected building program, while embodying the Institution's dual missions of health and education.

OBJECTIVES

The Landscape Master Plan's three objectives are:

- To develop open space and landscape concepts applicable to UMMS and its campus;
- To prepare planning and design guidelines for campus elements; and
- To prepare an illustrative Landscape Master Plan drawing, which applies the following concepts and guidelines to the specific site and projected building program.

PLANNING & DESIGN CONCEPTS

SUSTAINABILITY CONCEPTS

Physical open space and landscape concepts embodied in the UMMS Landscape Master Plan aim to maximize sustainability. Among them are:

Non-structural stormwater management. Anon-structural approach to stormwater management gives precedence to retention and detention strategies over reliance on subsurface utilities. This concept is realized in the proposed retention pond in the south central portion of campus and other detention areas proposed by the Project Civil Engineers. It is also seen in restrained use of curbing and a preference for porous surfaces.

Water efficiency. The inclusion of Native and drought-tolerant plantings, rooftop gardens, rainwater gardens, and gray water usage in the design of the campus landscape will promote water efficiency.

Heat Reduction. The Landscape Master Plan drawing illustrates two concepts for heat reduction. Planting tree-lined roadways and campus edges is one. The other is the development of green roofs for an athletic field atop the parking structure in the southwest corner and for a therapeutic garden atop the hospital expansion.

Plant Suitability. Specifying native plants is always appropriate, as they have proven to be suitable in a given area. The UMMS Landscape Master Plan takes this approach another step by proposing plant communities in accord with regional landscape types: pond, wetland, meadow and woodland. Campus lawns – those iconic, yet labor-intensive introductions - are limited to "The Green," to areas within discrete high profile quadrangles and to sidewalk planting strips.

Material Selection. Careful selection in favor of renewable, recycled and/or local/regional construction materials is another way to promote sustainability.

Transportation Alternatives. Reliance on the private automobile, and all its attendant consequences, is here to stay for the foreseeable future. While accommodating such reliance, the UMMS Landscape Master Plan also promotes alternative modes of transport such as walking and jogging, bicycling and bus-riding. Comfortable and convenient sidewalks and walkways are proposed throughout the campus. A 12-foot wide campus trail serves bicyclists, "power walkers" and joggers. Convenient bus stops, shelters and walkway linkages are proposed at the center of campus and along Belmont Street.

FUNCTIONAL CONCEPTS

Functional concepts encompass a wide range of concerns for campus identity, visitor orientation, safety, user-friendliness and amenity.

Multi-Usage. Multi-usage is perhaps the most significant functional concept because many of the ideas and strategies presented here fulfill several functions. For example, the campus trail is intended to serve walkers, joggers, bicyclists and small service vehicles. The pavement around the Green serves pedestrians as well as limited instances of vehicular use. The southwest garage accommodates parked vehicles as well as roof-top athletics.

Campus Identity. The Landscape Master Plan expresses several strategies to foster the unique identity of the UMMS campus:

1.) Edge treatment, readily visible both to visitors and to travelers along adjacent streets, is espe-

cially important. This proposal enhances the existing edge treatment by repairing and extending the stone walls that currently ring approximately half of the campus perimeter. It will be advisable to differentiate the detailing of these walls from those of abutters.

2.) Distinctive signage is an obvious identifying element along the campus edge at all access points, as well as at the critical intersections with Belmont Street. The Plan drawing features two large curved signage walls, which address Belmont.

3.) Framing views to landmarks and landscape features is a third strategy. Architectural massing insures that the Lazare Research Building retains its prominence.

4.) One view in particular is likely to become an iconic image for the campus. With the pond in the foreground, the pondside pavilion in the middle ground, and the Lazare Research Building in the background, the viewshed into the campus will be a distinguishing image. Once implemented, the view from the southeast corner of the pond will become a distinctive feature.

Orientation. Identity and orientation are closely related. Landmarks, landscape features and signage are effective for both. Distinctive gateways at campus entry points, such as the stone piers framing the central roadway termini along South Road, are primarily for orientation purposes, as are other forms of directional signage. UMMS administrators could also consider installing campus maps just inside the entry piers.

Safety. Ensuring safety for visitors and staff is a critical dimension of the proposed Landscape Master Plan. Separating pedestrians from vehicles as much as possible and promoting all-pedestrian precincts within quadrangles are two primary planning strategies reflected in the Plan. Other safety strategies involve specific recommendations for planting, lighting, paving and other site improvements, which are featured among the design guidelines below.

User Friendliness. Accessibility in accord with the Americans with Disabilities Act is the primary aspect of user-friendliness. Slopes and changes of grade on campus accommodate ADA compliance in all but a few instances. Elevators within accessible buildings provide an alternative route in these two cases; from the pond to the southeast quadrangle, and from the Green to the northwest quadrangle. Other aspects of user-friendliness – comfort and convenience – are also embodied in the Plan in the form of: internodal transportation linkages; trees and structures for sun, wind and rain; seating, drinking fountains and other furnishings.

Amenity. The concept of amenity goes beyond creature comforts to other dimensions of human need for social interaction, recreation, edification and contemplation. The UMMS Landscape Master Plan addresses all of these.

1.) All pedestrian areas on campus, for example, are designed to create a social context. Sidewalks and walkways are wide enough to accommodate at least two pedestrians walking side-by-side, building entrances are conceived as outdoor foyers, and seating is readily available for people-watching. The bench niches and Café Terrace on the Green are particularly conducive to sociability. Active recreation facilities are also on the Plan, in the form of the rooftop athletic field, the courts, and the Campus Trail with its linkages beyond campus to Lake Park.

2.) The Master Plan also provides for contemplation, or de-compression in the midst of the stressful environment of a medical school and hospital, in the form of quiet quadrangle spaces, a pondside pavilion, a rooftop therapeutic garden and memorials. The rooftop therapeutic garden is an integral part of the expanded hospital complex.

3.) Memorials and dedications of different kinds will be a welcome addition to the campus landscape, provided they are well-considered and designed according to an overall plan and policy. The Landscape Master Plan recommends consideration of four categories, as may be seen below in Design Guidelines, Landscape Features.

4.) Naming discrete landscape features may also be appropriate: the café on the Green; the pondside pavilion; the bridge; and the pond, itself, come to mind. Interpretive signage for special features – the New England landscape types (pond, wetland, meadow and woodland) and sculptures, among others - should be budgeted and included as the Plan is implemented.

AESTHETIC CONCEPTS

The UMMS Landscape Master Plan envisions a campus where open space is a key ingredient in the experience; where diversity complements an aesthetic whole; where small and large-scale meet; and where visitors discover an array of pleasing views into and from within the campus.

Spatial Definition. Open spaces are active ingredients in the formation of the proposed UMMS Master Plan, rather than simple voids surrounding buildings. The proposed buildings are arrayed to define or surround meaningful outdoor places. Three new building clusters, for instance, create classic collegiate quadrangles in all but the northeast corner of the site.

The foremost example of spatial definition in the Master Plan is the central north-south spine of the campus – comprising the Green and Pond. This spine is the organizing principle for the six buildings that abut it and delineates the core of the campus.

Diversity/Unity. Each discrete open space on the proposed UMMS campus – each quadrangle and the Green – shall have some degree of differing character, through variations in form and materials. Campus edges shall be differentiated, as well, through variations in landscape type. Northern campus portions shall be wooded and southern portions shall evoke meadows, wetlands and ponds. However, an underlying unity shall encompass each open space, through design simplicity and standardization of materials and details.

Scale. The campus-wide site elements - furnishings, light posts, trees and other plantings, pavilions and shelters - will mitigate the impact of the large academic buildings. Canopy trees are particularly effective in this regard: they often frame views and limit eye levels, while offering contrast to building heights. The gradations in building height and building mass which are proposed by the architects – larger at the center and smaller at the edges – are also effective strategies for achieving an appropriate sense of scale.

Views. Effective management of viewing angles and corridors will play an essential role in the UMMS Master Plan's artistic success. Accordingly, the Plan sets up two long views which are framed by buildings: north and southward across the Green and pond, and east and westward over the central roadway. Partial views into quadrangle interiors from corner access points promise to draw visitors into more intimate spaces. Conversely, the Master Plan proposes the screening of service areas and the partial screening of garage structures.

DESIGN GUIDELINES

The aforementioned planning concepts describe the approaches and decision-making rational that went into the development of the UMMS Landscape Master Plan. This section sets forth design guidelines for an array of of physical campus elements, which describe design intent as well as specific criteria and standards. The campus elements are: access, circulation and parking; open space and recreation; and landscape features.

ACCESS, CIRCULATION AND PARKING

The circulation plan is designed to provide pedestrian access and efficient traffic flow while eliminating conflict between vehicles and pedestrians. It also encourages alternative modes of transportation and enhances the visual character along circulation routes. Elements of the plan include:

Pedestrian Circulation maintains pride of place in the Guidelines, given the intent of the Master Plan: to be ADA compliant; to make the UMMS campus more pedestrian-oriented; to foster linkages with other circulation systems on and off-campus. Pedestrian orientation strategies include: roadway removal within the central open space corridor; the creation of a hierarchical walkway system throughout campus (described below); a separation of pedestrians from vehicles where possible; a quantitative increase in the number and size of pedestrian ways; and crosswalk improvements. The campus pedestrian circulation also links to other trails and modes of transportation: to existing roadways, to the nearby parklands, to off-campus bus stops, and to bicycle accommodations.

- ADA walkway accessibility is accommodated throughout campus, in all but a few instances, with slopes at a grade of less than 5% or with ramps having a slope up to 8.33% in selected areas. Significant grade changes in the northwest and the southwest campus areas are accommodated with building elevators.

  Basic ADA walkway requirements include:

  Grades- The maximum walkway slope is 5%. Ramp slopes extend from 5% - 8.33%. Ramps require railings on both sides of the walkway, with a 12" railing extension beyond the top and bottom of the ramp. Ramps require 5' landings with every 30" change in elevation.

  Dimensions- Walkways must maintain a minimum width of 5 feet. If walkway dimensions are less than 5' (a minimum of 4'-6"), a 5'-square area must be provided every 200' or less. Walkways must also maintain a minimum of 3' around obstacles. Curb

ramps must be a minimum of 3' wide, exclusive of flares. Curb ramps must run parallel with the direction of travel, that is, there must be two at each corner.

Materials- ADA accessible walkways should be concrete or bituminous concrete, according to pedestrian walkway guidelines above.

Notes- Ground surfaces must be stable, firm, and slip-resistant. Changes in level should be less than ¼" (6mm) across all surfaces. Changes in level between ¼" and ½" (6mm and 13mm) should be beveled with a slope no greater than 1:2.

• **The Promenade** is the premier walkway on both sides of The Green. Clusters of niches are located along its length, which provide small defined spaces for seating and socializing. *Figure 1* is an example of such a niche. Overhead, along the eastern promenade is an arbor structure with a pavilion at its southern end, marking a gateway to The Green and the center of campus. *Figures 2 and 3* show comparable promenades in Boston and Cincinnati, suggesting two divergent possibilities for the arbor's materials and details. Regardless of the style however, the Promenade on both sides of The Green needs to accommodate occasional vehicles, such as ambulances, small service vehicles and VIP visitors. Specific guidelines are:

Dimensions- The Promenade should maintain a 12' width and should have an overhead clearance at a minimum of 10'.

Materials- The Promenade walkway should be constructed of ADA compliant brick or concrete pavers, with changes in level should be less than ¼".

Notes- One side of the border will be lined with lush, colorful ornamental plantings. The walkway paving must be constructed to allow occasional emergency, service, and VIP vehicle access.

• **Primary Walkways** between and within campus areas and quadrangles are designed primarily for pedestrian usage and circulation convenience. They will be separated from vehicular traffic, will link buildings across quadrangles and will provide direct access to every building. The Plan envisions many

Figure 1

Figure 2

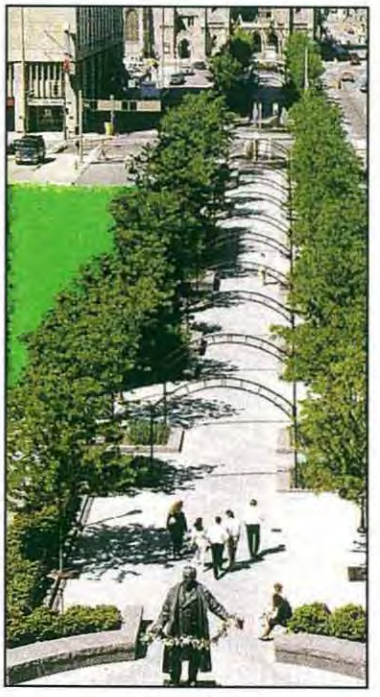


Figure 3

such walkways lined with trees, as shown in *Figure 4*. In grade transition zones, such as between the central and western portions of the campus, primary walkways will need to combine stairs and ramps. *Figure 5* shows the distinctive and dramatic possibilities inherent in such a requirement.

Dimensions- The primary walkways should maintain an 8' width.

Materials- Primary walkways should be constructed of concrete or bituminous concrete lined with pavers.

Notes- While primary walkways are principally for pedestrians, they will share the pavement with bicycles for building access.

- **Secondary Walkways** are designed to avoid compacted "desire lines" by connecting primary walkways, circulation routes and buildings.

Dimensions- Secondary walkways should maintain a 5' width, to accommodate two people passing or walking side-by-side.

Materials- Secondary walkways should be constructed of concrete or bituminous concrete lined with pavers.

- **Sidewalks** are the same as walkways except that they closely parallel roadways. The Plan proposes that all sidewalks be separated from the roadways by a planting strip with canopy trees, as shown in *Figure 6*. This figure also illustrates the proposed character of campus boundaries, as described below.

Dimensions- Sidewalks on interior of campus should be a minimum of 6' in width. Sidewalks along exterior roadways should be a minimum of 8' wide and will share with bicycles.

Materials- Sidewalks should be constructed of concrete or bituminous concrete.

Notes- Sidewalks should be separated from roadways by a six-foot tree planting belt.

- **The Campus Trail** presents another option for pedestrians. The Campus Trail is essentially multi-use, intended for walking, jogging, bicycling, skate

Figure 4

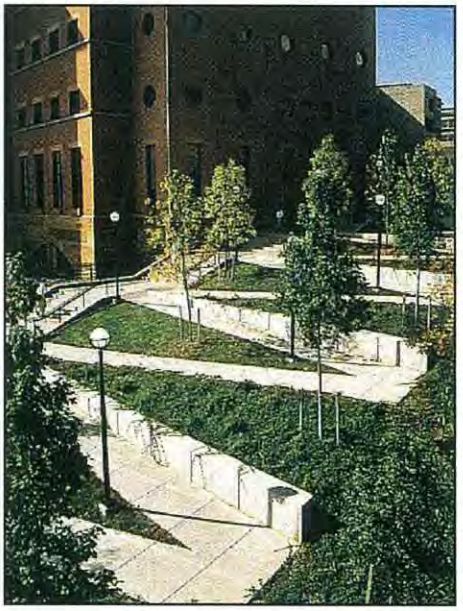


Figure 5

Figure 6

boarding, as well as small UMMS service vehicles. Lengths of the Trail are within the southern buffer zone, cross-campus between Plantation Street and Lake Avenue North, and cross-campus between Belmont Street and North Road. *Figure 7* illustrates how such a multi-use trail may look.

Dimensions- The multi-use Campus Trail should be 12'-wide.

Materials- The Campus Trail should be constructed of bituminous concrete with concrete or paver edging. A center stripe will designate two-way bicycle flow.

Notes- Niches for benches should have a minimum 4' setback and be constructed of concrete pavers. Benches should be located every 400', and water fountains should be located every 1200' along the Campus Trail.

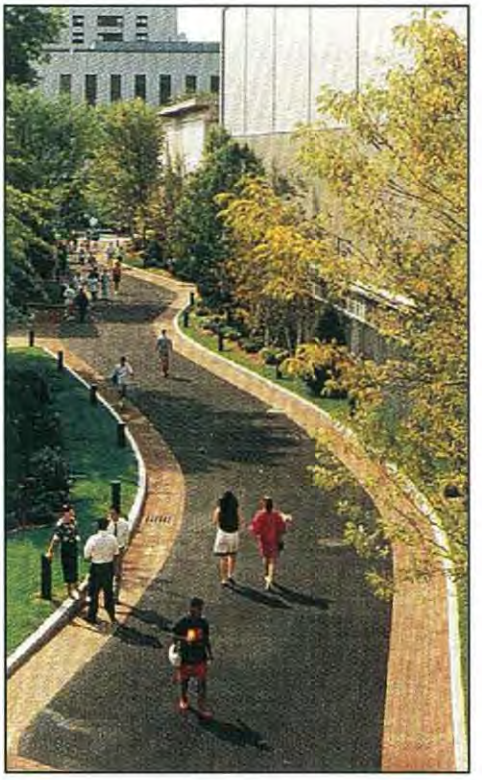


Figure 7

- **Crosswalks** will be identified with signage and typical pavement striping. The main east-west roadway crosswalks will be identified with textured paving, to link the central open space corridor, The Green, and the pond. The premier crosswalk, comprised of a 180'-wide band of pavers and regulated by stop signs, links the northern and southern sides of South Road at the center of campus. Other crosswalks will be identified by signage and both textural paving changes and striping.

Dimensions- The premier crosswalk, linking both sides of South Road, should be 180' wide. Other crosswalks will typically match the width of the walkway or sidewalk.

Materials- The premier crosswalk will be composed of pavers. Other crosswalks will use textural paving and striping.

Notes- Crosswalks will be identified by textural paving changes, striping and stop signs. The premier crosswalk will use bollards along both sidewalks. A pedestrian-activated in-pavement flasher system should be considered for particularly dangerous intersections and crossings.

Vehicular Circulation includes a hierarchy of roadways, with a primary east-west thoroughfare, loop roads, garage access driveways, service access roads and a multi-use Campus Trail. Canopy trees will be planted along all roads throughout campus.

- **The major east-to-west roadway**, South Road, will be aligned with intersections at both ends.

Dimensions- The South Road width will vary with circumstances. A 58' width will be used at access points for the four 12' two-way travel lanes with a central 10' boulevard planting island. A 64' roadway width will be utilized at the campus center to accommodate four travel lanes and two 8' bus pull-off lanes. For the remaining segments of South Road, a 48' width will be used for four 12' two-way travel lanes.

Materials- Roadways will be of bituminous concrete.

Notes- Canopy trees will be placed between sidewalks and roadways to buffer pedestrians from traffic. Screen plantings will be utilized to screen service and parking areas.

- **Loop roads** will facilitate passenger drop-off and short-term parking. Two loop roads will be used along the major east-west roadway, to access both hospital entrances and the Lazare Research Building.

  Dimensions- The loop roads will be one-way and 12' in width.

  Materials- Loop roadways will be bituminous concrete with pavers at along the northern end of the loop road that crosses The Green.

  Notes- Bollards, at the northern end of the loop road that crosses The Green, will separate pedestrian and vehicular circulation. The same bollards will also be used at the premier crosswalk.

- **Garage access driveways** will be located for three garages accessed from off-site roadways and for two garages accessed from the main east-west roadway.

  Dimensions- Driveways will be two 12' lanes for two-way traffic.

  Materials- Garage access driveways will be of bituminous concrete.

- **Service access** for trucks will be through driveways and garages. Small vehicles will use the multi-use Campus Trail, with bollard access control. Service access to the buildings in the southwest campus corner will be through the southwest parking garage and under the cantilevered balcony of the Athletic Complex.

  Dimensions- Service access for trucks should conform to the City of Worcester's emergency vehicle access regulations with a sufficient turning radius for fire engines.

  Materials- Service access roadways will be of bituminous concrete.

  Notes- For service access to buildings in the southwest campus corner, the Design Development phase will specify exact dimensions with input from an engineer. All service areas will be screened from roadways, walkways and buildings with plantings and/or a fence.

Bicycle Circulation will use shared roadways and walkways on the UMMS campus.

- **South Road** will be identified as a "shared road" through the use of signage to alert drivers of potential cyclists.

  Dimensions- The multi-use Campus Trail will be 12' wide with a center stripe to designate two-way bicycle flow.

  Materials- Materials for bicycle circulation shall follow guidelines under pedestrian and vehicular circulation, as noted above.

  Notes- **Portable Bicycle Racks** will be mounted on buses to accommodate cyclists coming to campus from other destinations. **Bicycle Racks** will be placed in close proximity to every building entrance. **Bicycle Lockers** should be considered at bus stops for overnight storage.

OPEN SPACE AND RECREATION

Open space is a vital component of any campus and, in this case, the major organizing principle for the orderly arrangement of new buildings. It enhances the visual quality of the campus and provides active and passive recreational opportunities for all campus users – faculty, staff, patients and visitors.

The UMMS Landscape Master Plan proposes a hierarchy of campus open space: areas of principal importance are represented by the central Green, the Pond and the Belmont Street Frontage; secondary open space is found in the quadrangles and the Athletic Complex; and tertiary areas are comprised of the therapeutic garden and buffer zones.

Primary Open Space not only enhances the visual quality of the campus and provides recreational opportunities, but it presents a cohesive image and identity for the urban campus.

- **The Green** is the premier open space envisioned for the future UMMS campus. It comprises a massive rectilinear lawn panel, stretching north/south through the center of campus. Though this panel is interrupted in two places to accommodate circulation, its essential unity is assured by the continuity of lawn areas, by the stately promenades on both sides and by building frontages, which surround it on three sides to define the spatial boundaries. The Green's extremities are marked by a proposed pavilion to the south and by a sculpture piece to the north. A second pavilion is located mid-way, suggesting the possibility of a café. Seating niches along the promenades should become another attraction for people. *Figures 3 and 8* serve to illustrate the Green's basic character – a simple broad open lawn area defined by substantial buildings that is animated along the edges.

  Dimensions- The Green is 150' wide and 580' long overall.

  Materials- The primary planting material is turf grass.

  Notes- The Green should be graded to accommodate occasional athletics, reunions, commencement activities, and special events.

Figure 8

- **The Pond** is the southern extension of the Green that extends to an intersection with the Belmont Frontage. Functioning physically as stormwater retention, the Pond promises to become much more: a UMMS campus icon and a source of enjoyment for all. *Figure 9* conveys the design intent for the Pond as a large reflective surface in scale with proposed development and bordered by native plantings. *Figure 10* is a glimpse near the Pond's island and bridge, where a narrow channel may be designed for access to the water.

  Dimensions- The pond depth will vary. It should be determined during Design Development phase according to stormwater requirements and proper depth needed to discourage eutrophication, to encourage oxygenation, and to maintain a healthy ecosystem in the pond. A planting shelf, vary

Figure 9

Figure 10

ing from 18"-36", should be incorporated along most edges of the pond to support aquatic plants.

Materials- Soils studies should be undertaken during the Design Development phase to determine soil types and water retention capabilities in the pond area. Pond liner materials will probably be clay.

Notes- Sediment traps should be used at outfalls to prevent sedimentation of the pond. All pond edges will be planted to discourage erosion. Floating, solar-powered fountains may be used to encourage oxygenation.

- **The Belmont Frontage** represents the first impression the UMMS campus makes to visitors and motorists along State Route 9 (Belmont Street). As such, it is important that the view convey the identity and desired image of UMMS as a whole. The frontage may, in fact, be the only thing many people will see of the campus. The Plan proposes to extend the existing stone wall to encompass the entire campus edge. Along Belmont Street, in particular, this wall will stand between a double row of canopy trees. One row of trees will be located within the sidewalk planting strip and the other row will be behind the wall, filling in spaces where trees do not already exist. *Figure 6* illustrates this proposal. The vision for the set-back between the campus boundary and the indented building line features the Campus Trail weaving its way around and through a wetland and meadow. *Figure 11* is a representation of this image. The Trail's convex curvature at both ends of the Belmont Frontage (at the Plantation Street and Belmont Street intersection and at the Lake Avenue North and Belmont Street intersection) is marked by a curved wall. On the outside, the wall holds the UMMS gateway signage. *Figure 12* illustrates this idea. The inside of the wall will enclose a curved bench, perennial plantings and a memorial wall.

Dimensions- The Belmont Street Frontage is approximately 2,200' long.

Materials- The sign materials should be granite to complement the existing stone walls.

Notes- Canopy trees should fill in gaps between existing trees. The UMMS gateway signage should be lit at night and the lettering should be at a scale appropriate for passing motor vehicles.

Figure 11

Figure 12

Figure 13

Secondary Open Space on the UMMS campus is represented by the Quadrangles and the Athletic Complex.

- **Quadrangles** are four-sided open spaces framed by buildings. Aside from the Green – itself a large rectilinear quadrangle – the campus Plan features five quadrangles arrayed around the campus core. The three corner quadrangles are enclosed on all four sides. The northern Medical Office Building quad is enclosed on three sides, not atypical by traditional standards. Although the open space north of the main Plantation Street entry may not qualify as a quadrangle per se, it is a green bounded on two sides by an L-shaped building that will be defined by canopy trees on its other two sides. The quadrangles' landscape plans are deliberately varied to achieve a sense of place for each. While *Figures 13, 14, and 15* suggest several possibilities for how these spaces might appear, they convey the expectation that quadrangles will serve as semi-private venues for passive activities.

  Dimensions- Dimensions of each quadrangle will vary.

  Materials- Materials of each quadrangle will vary.

  Notes- Quadrangles are viewed as possible places to install water features and sculpture.

Figure 14

- **The Athletic Complex** in the southwest corner of campus is a rooftop development, situated atop the proposed southwest garage. It is an important component of the Landscape Master Plan serving a number of valuable functions, both as recreation for faculty, staff and students, and as a visual amenity in lieu of parked cars (from the highest point on Belmont Street looking into the campus). Most of the rooftop is occupied by a versatile athletic field. To the south, partially cantilevered beyond the edge of the garage structure, are two ball courts offering opportunities for tennis, basketball and volleyball. The remaining area features a sun terrace, a pavilion for picnics and shaded seating with accessible ramps and steps.

  Dimensions- Overall dimensions are 210' x 280'.

  Materials- Materials will vary.

Figure 15

Notes- While the athletic field is somewhat smaller than a conventional field, athletic field standards should be consulted before construction.

Tertiary Open Space on the UMMS Landscape Master Plan is varied, comprising a therapeutic rooftop garden and campus buffer zones.

- **The Therapeutic Garden** is a roof-top development situated atop the proposed Hospital garage. From the Garden entry, Hospital patients and staff will wend their way along meandering paths, bordered by rocks and overhanging plants. Most planting beds will be raised to accommodate enjoyment by infirm and wheelchair-bound patients. Paths lead to the eastern end of the garden, where they straighten to become an esplanade bordered by a long seating bench. Visitors will most likely sit here to enjoy panoramic views to the Lake. *Figures 16, 17 and 18* show a range of possibilities.

  Dimensions- Overall dimensions are approximately 240' x 180'.

  Materials- Walkways must be ADA accessible.

  Notes- A pavilion is planned for the Therapeutic Garden. Plants should be selected for fragrance and color. The Design Development phase should specify appropriate plants and trees for rooftop gardens.

- **Campus Buffer Zones** will express UMMS identity via uniformity of the stone wall edge treatment. The campus buffer zone types along different roadway frontages will vary, however, in response to solar orientation and interior campus conditions. The aforementioned Belmont Frontage, facing intense and somewhat chaotic conditions of commercial strip development, will be buffered by a double row of canopy trees, behind which are a meadow and wetland.

A single row of canopy trees will line the street side of sidewalks along Plantation Street and Lake Avenue North. The stone wall along these frontages will be marked by distinctive stone piers on either side of entry gateways. Plantings within these east and west buffer zones will be mixed mead-

Figure 16

Figure 17

Figure 18

ow and woodland types, with screen plantings clustered informally in front of parking structures.

The stone wall continuing along North Road will be backed by a single row of canopy trees, where space allows. Behind that, the Plan envisions a New England woodland buffer zone, advancing to the edge of existing and proposed buildings, as shown in *Figure 19.*

Recreation is expanded in the UMMS Landscape Master Plan with more opportunity to pursue passive and active recreational interests on campus.

- **Active Recreational Features** include those already introduced in the text above: the rooftop Athletic Complex and multi-use Campus Trail. The other notable active recreation components are the two existing play courts on North Road. The Plan retains these courts and integrates them more fully into the campus setting with new walkways and an adjacent stone boundary wall, which will double as seating.

  Dimensions- Existing court sizes are approximately 130' x 80'.

- **Passive recreational venues** are proposed throughout the Landscape Master Plan for UMMS. Venues for relaxation, decompression or socializing are especially important for people on a medical school and hospital campus, where high pressure endeavors and stressful circumstances prevail. The Green, as noted earlier, features promenades with sitting niches as well as a café with an adjoining terrace. The Pond displays a waterside pavilion, with benches along surrounding walkways and pond-side seating. The Belmont Frontage has two corner memorial/garden rest areas. The northwest quadrangle possesses a café terrace and all the quadrangles have seating. The rooftop Athletic Complex features a sunny social terrace and picnic pavilion. The rooftop Therapeutic Garden contains exploratory paths with lush planting beds, an esplanade overlook and a pavilion.

LANDSCAPE FEATURES

The term landscape features encompasses both natural and cultural aspects of the UMMS campus. This third and final campus category refers to site features, as much as it does to the natural phenomena of topography, microclimate and planting.

Natural Features include topography, microclimate and plant materials.

- **Topography**

The UMMS Master Plan takes advantage of the campus site's terrain as it slopes gently downward from west to east. Proposed parking structures are tucked into the slopes. The proposed stormwater pond is cut into a swathe of relatively level terrain to spatially extend the central campus Green. The wetland within the Belmont Frontage is simply an enhancement of an existing swale.

- **Microclimate**

The Master Plan takes microclimate into account, to moderate climatic extremes. Terraces are located for southern exposure during winter months, the Promenade arbor is located for protection from afternoon heat, and the woodlands are located to buffer northern and northwestern winter winds.

- **Plant Materials** of the naturalized areas– pondside, wetland, meadows and woodlands – shall consist of native species, selected and arranged in accord with typical New England plant communities. Other plant materials within the Green, in beds, in borders, in quadrangles and along selected foundations, shall include both native and specimen plant species, selected for low-maintenance culture, drought tolerance and multi-seasonal interest. For safety and surveillance, shrub masses near walkways should be low enough to allow eye-level viewing. Canopy trees will be planted along all roads throughout campus. Canopy trees will be placed between sidewalks and roadways to buffer pedestrians from traffic. Screen plantings will be utilized to screen service and parking areas.

- **Lawns** areas on the UMMS campus shall be limited to the Green, to individual Quadrangles and to sidewalk planting strips.

Site Improvements are elements in the landscape that complement the architecture, provide amenities for people and distinguish the campus. It is important that these elements utilize a consistent style to unify the campus. They are:

- **Accessory structures** featured in the Landscape Master Plan include: the Green's arbor and

pavilion, as seen in sample *Figures 2, 3, 8 and 20*; the café pavilion on the Green; the pond overlook pavilion, the athletic complex pavilion; the therapeutic garden pavilion; a bridge over the pond; and three bus stop shelters. With two exceptions, these structures should be conceived together in a way to express campus unity. The therapeutic garden pavilion may be different from the others since it will not be easily visible from the ground. As part of an exploratory garden, it may in fact, be quite fanciful. Also, the proposed Belmont Street bus shelter should be constructed with stone to match the wall behind it.

Figure 20

- **Outdoor foyers** – meaning an exterior entryway space expansive enough for several people to converse and perhaps also to sit - should adjoin the main entry to every new building. *Figures 21 and 22* illustrate the intent for seating and artwork at quadrangles.

Figure 21

- **Site furnishings** include seating, trash receptacles, bicycle racks, bollards and drinking fountains. Benches and seat walls shall be easily available on the UMMS campus. *Figures 23, 24, 25 and 26* illustrate seating examples. They are clustered in strategic locations along the Green or in quadrangles and line walkways at intervals no further than 200' apart. Along high traffic walkways, benches shall be set back into niches, as in *Figure 27*.

Sturdy, moveable individual chairs, as represented in *Figure 28*, shall be a preferred seating option on rooftop developments, the athletic complex and the therapeutic garden. Metal café tables and chairs shall furnish the two proposed campus terraces on the Green and in the northwest quadrangle. These shall be set out on a seasonal basis and secured at night.

Figure 22

Trash receptacles, a sample is seen in *Figure 29*, recycling bins and bicycle racks shall be located near café/sitting terraces, pavilions, bus stop shelters and the primary entry point to quadrangles. Bicycle racks shall be located in close proximity to every building entrance. In keeping with the Landscape Master Plan's aim to maximize sustainability, recycling bins and trash receptacles, as seen in *Figure 30*, should be located inside all building entrances, rather than outside, for ease of maintenance.

Figure 23

Drinking fountains shall be provided along the Campus Trail approximately 1200' apart and next to athletic facilities.

Figure 24

Figure 25

Figure 26

Figure 27

Figure 28

Figure 29

Figure 30

Proposed bollards separate vehicular and pedestrian areas at the northern end of the loop road across The Green, as in *Figure 31*. They are also used at the southern end of The Green, along South Road, on both sides of the street, to further define the premier crosswalk.

Lighting is a necessary and significant campus landscape feature. Light post fixtures are the most significant lighting element, given their constant physical presence. Such fixtures should be sturdy, easily maintained, replaceable, energy-efficient, and specified and spaced for appropriate lumen levels. Beyond that, they should be an attractive unifying campus feature, suited to campus architectural style and scaled for their particular application. Light posts along walkways and within pedestrian areas should have a standard height of approximately 14'. Figures *32, 33 and 34* illustrate possible lighting fixtures. As part of the concept of sustainability, lighting fixture lamps should be shielded to direct light to targeted areas, to avoid glare, to prevent light pollution and to avoid wasting energy resources.

Site-specific circumstances will suggest the advisability of other approaches to lighting, such as illuminating building facades, spot or flood-lighting signage and other features, and up or down-lighting for trees and planting areas. *Figure 35* illustrates the design intent of the pond pavilion being lit and reflected across the water, as part of the UMMS campus iconic image.

- **Gateways** can be defined by the use of formally designed planting areas in combination with signage for orientation and way finding. Gateways delineate the primary entrances into the UMMS campus. Signage and stone walls are located at both ends of South Road to identify the gateways into the campus.

- **Signage** is for campus identity, visitor orientation and direction, regulation and interpretation. Other than standard regulatory signs, UMMS campus signage should be conceived as part of a comprehensive program. As such, every sign will enhance campus identity and distinction. Directional signs are located at the gateways into campus on both ends of South Road. Landmark signs are located at the southeast and the southwest corners of the campus and serve to distinguish the university boundaries, as seen in *Figure 12*.

Figure 31

Figure 32

Figure 33

Figure 34

Special Features are customized cultural elements which contribute distinctive landscape highlights to the UMMS Plan.

- **Memorials and Dedications** of different kinds will be a welcome addition to the campus landscape, provided they are well-considered and designed according to an overall plan and policy. The Landscape Master Plan recommends consideration of four categories.

First is the naming of a special landscape feature in honor of someone – a deceased UMMS personage or a donor: the pond, the bridge, the garden or an individual pavilion. The dedicatory signage for such a memorial will vary in accordance with the feature itself.

The aforementioned curved corner signs present opportunities for two memorial walls within the Belmont frontage, each dedicated to a specific group of individuals – faculty members, alumni or others, as may be deemed appropriate. Large bronze tablets could be installed initially, to which individual plaques would be added over time. Proposed seating and planting in the vicinity will add to the memorial's ambiance.

A program for dedicating benches provides numerous opportunities throughout campus. UMMS might consider inscribing and mounting a standard 4"x1" brass plaque on bench backs in appreciation for a $2,000 gift or some other amount, as determined by the Development Office.

A program for inscribing and installing individual pavers within the pavement around the Green is a great opportunity for still more memorials, dedications and expressions of donor appreciation. Dedicatory pavers should differ from surrounding pavers only by the presence of their inscriptions. Such pavers should be oriented in all different directions so there will be no one right way to see them.

Individual trees should not serve as memorials, as they may be damaged over time. Signs at the base of memorial trees are often mowing hazards, as well.

- **Art Works** will be a welcome addition to the campus landscape as well, provided they are of the highest quality, well-sited, appropriately scaled and of durable materials. *Figures 36, 37 and 38* illustrate these design intentions. The Landscape

Figure 35

Figure 36

Figure 37

Master Plan features two specific sites for large-scale sculptures: at the northern end of the Green and within the central western quadrangle. Smaller sculptures or fountains for the refreshing sound of water may be suitable within other quadrangles, as seen in *Figures 39 and 40*. Mosaic pieces may be suitable on selected wall areas, as determined during the course of architectural design development, or other surfaces. Ornamental metal gates may also be suitable for gateways.

Figure 38

Figure 39

Figure 40

UMass Worcester
Landscape Master Plan

Denig Design Associates, Inc.
Landscape Architects
142 Main Street
Northampton, MA 01060

TSOI / KOBUS & ASSOCIATES
ARCHITECTS

University of Massachusetts Medical School

Section VII. Design Guidelines

DESIGN GUIDELINES

Campus Edges and Campus Entries

The intent of the guidelines regarding campus edges and entries is to create a clear, discernible boundary line for the University, one that marks the edges of the place and strengthens campus identity. One should have a strong understanding of where the edges of the campus are, from all sides, and when one is entering the site. Components of these include:

- A green buffer along Belmont Street (Route 9)
- A clear academic entry at Plantation and Belmont Streets
- A clear clinical entry at Lake and Belmont Streets
- South Road, east and west intersections, as major campus entry points
- Automobile parking at the periphery

Campus Open Spaces

The campus spaces should act in unison to reinforce the identity of the whole university. The spaces that the new buildings create should create well-proportioned, humanly-scaled environments. Hierarchy of spaces must be clear with the Central Green being the most prominent and the surrounding courts being secondary. Sightlines to building front doors should be open and obvious. Uses for the space, whether for car or for pedestrians, should be clear and the two uses should be separated whenever possible. Spaces should be interconnected. Progressions from one space to another should be easily understood as well as offer moments of delight. Courtyard configurations should take advantage of their solar orientation and provide proper campus uses where appropriate. Components of these include:

- A clear hierarchy of green spaces
- Clear points of entry into each space
- Clear sightlines to building entries
- Well-proportioned, humanly-scaled spaces
- A proper and understandable separation of auto and pedestrian traffic
  Courtyard spaces at the southwest, southeast and northwest are to be reserved primarily for pedestrian use
  The Central Green will have three tiers:
  1. North Tier is primarily pedestrian use
  2. Mid Tier, at South Road, is primarily automobile traffic, providing access to the LRC, central parking and hospital entry
  3. South Tier is reserved for pedestrian use, set in a natural landscape

Building Heights and Mass

The intent here is to set limits to proposed building heights and building mass to best support the master plan goals.

- No building will be taller than the Aaron Lazare Medical Research Building (LRB).

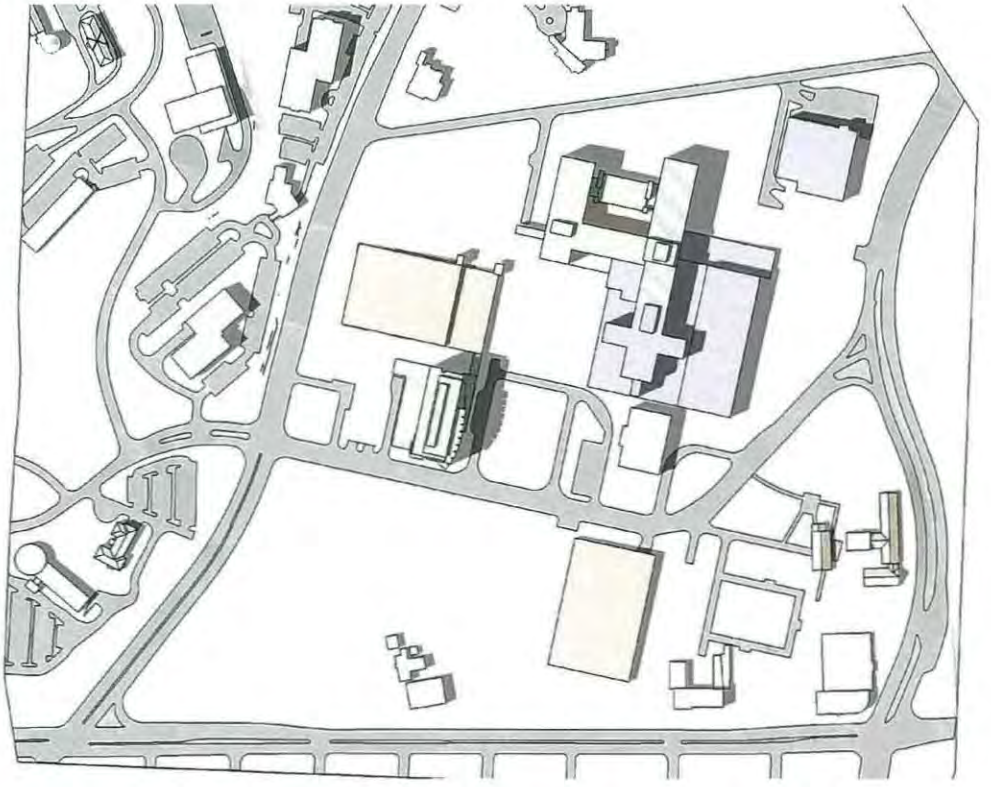
- Building heights along the immediate campus perimeter will be no higher than 5 levels
- Building heights along the campus green will be no taller than 7 levels

Building Character

This section relates to the quality of each individual building design.

- Each building design must have a clear point of entry, recognizable from a distance
- Service docks must hidden from primary views
- Exterior materials and building motifs must balance with existing campus buildings
- Building edges along courtyards must be animated with pedestrian-related uses
- All mechanical equipment must be either is a penthouse or fully screened on all sides

Figure VII.1



Sustainable Design

Excerpt from DCAM's 9/17/03 project scope description

"The master plan should incorporate siting and building desing concepts which incorporate the philosophical precepts of green design, including the use of passive

energy saving elements. Incorporated into this should be planning for how deferred maintenance can be accomplished in such a manner as to enhance the green aspects of building repair and renovation. Use the LEED program as a guide to determine efficiency of proposed green design."

Below is an outline of the five environmental categories into which LEED is organized. At the project implementation phases, each should be evaluated for relevance and application to the UMMS campus master plan. It is not the intent of this study to seek a LEED certified master plan, site or building solution, but rather to encourage green design inititatives.

		Potential For:	
Sustainable Site		**Campus**	**Buildings**
PR1	Erosion & Sedimentation Control	x	
C1	Site Selection - *Review Wetland Status*	x	
C2	Urban Redevelopment - *Min FAR 1.37*	x	
C3	Brownfield Redevelopment		
C4	Alternative Transportation - *Bikes, Buses, Trains?*	x	
C5	Reduced Site Disturbance - *Maximize Open Space*	x	
C6	Stormwater Management - *80% Recharged DEP*	x	
C7	Landscape & Exterior Design to Reduce Heat Islands - *Underground Parking, Shade Trees, Roof Gardens*	x	
C8	Light Pollution Reduction	x	
Water Efficiency			
C1	Water Efficient Landscaping	x	
C2	Innovative Wastewater Technologies - *ex: NE BioLabs*	x	
C3	Water Use Reduction		x
Energy & Atmosphere			
PR1	Fundamental Building Systems Commissioning		x
PR2	Minimum Energy Performance		x
PR3	CFC Reduction in HVAC & R Equipment		x
C1	Optimize Energy Peformance		x
C2	Renewable Energy - *Solar, Wind, Biomass?*	x	
C3	Additional Commissioning		x
C4	Ozone Depletion		x
C5	Measurement & Verification	x	
C6	Green Power	x	
Materials & Resources			
PR1	Storage & Collection of Recyclables	x	

		Potential For: Campus	Buildings
C1	Building Reuse	x	
C2	Construction Waste Management		x
C3	Resource Reuse		x
C4	Recycled Content		x
C5	Local/Regional Materials		x
C6	Rapidly Renewable Materials		x
C7	Certified Wood		x
Indoor Air Quality			
PR1	Minimum IAQ Performance		x
PR2	Environmental Tobacco Smoke (RTS) Control		x
C1	Carbon Dioxide (CO_2) Monitoring		x
C2	Increase Ventilation Effectiveness		x
C3	Construction IAQ Management Plan		x
C4	Low-Emitting Materials		x
C5	Indoor Chemical & Pollutant Source Control		x
C6	Controllability of Systems		x
C7	Thermal Comfort		x
C8	Daylight & Views - *Building Orientation*	x	x
Innovation & Design Process			
C1	Innovation in Design	x	x
C2	LEED™ Accredited Professional	x	x

Proposed Site Guidelines

Figure VII.1

- **Maximum Height**
  LRB - 10 feet
  Future buildings should be 10 feet shorter than the Aaron Lazare Medical Research Building (LRB) to enhance its presence as a landmark and campus gateway
- **Central Quadrangle**
  Pedestrian Oriented
  The northern portion of the central quadrangle should be designed free of vehicular traffic except for emergency vehicle access
- **Green Edges**
  Major campus boundaries should be developed with indigenous and manicured landscape treatments
- **Lower Height at Plantation Street**
  Buildings along this edge should be consistent with the adjacent zoning height limit of 50 feet
- **Parking/Traffic Thresholds**
  Maximum site capacity and density should be kept in balance with recommended parking ratios and off-site traffic mitigation measures
- **Density Target - FAR**
  To optimize holding capacity and to promote a vibrant interactive campus a floor area ratio (FAR) of 1.2-1.5 is recommended

Corner of Plantation Street and South Road

Aaron Lazare Medical Research Building

Lake Avenue/South Road

Lake Avenue Looking South

Central Quadrangle

South Parking Structure

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Section VIII. Projected Area Summaries

PROJECTED AREA SUMMARIES

The project plan may be divided into four quadrants, with South Road and Center Green acting as the dividing lines.

Northwest Quadrant

- Parking Structure
  1,930 cars on 4.5 and 5 levels
- Research/Academic Building A
  100,000 GSF on 5 levels
- Research/Academic Building B
  78,000 GSF on 6 levels
- Research/Academic Building C
  100,000 GSF on 4 levels
- Research/Academic Building D
  158,000 GSF on 3 and 4 levels
  Parking below building, 300 cars on 3 levels
- Academic Addition
  18,000 GSF on 2 levels

Northeast Quadrant

- Parking Structure
  2,450 cars on 6 levels
- Hospital Bed Tower A
  135,000 GSF, 300 beds on 6 levels
- Hospital Bed Tower B
  135,000 GSF, 300 beds on 6 levels
- Hospital Support Building
  127,000 GSF on 5 levels

Southeast Quadrant

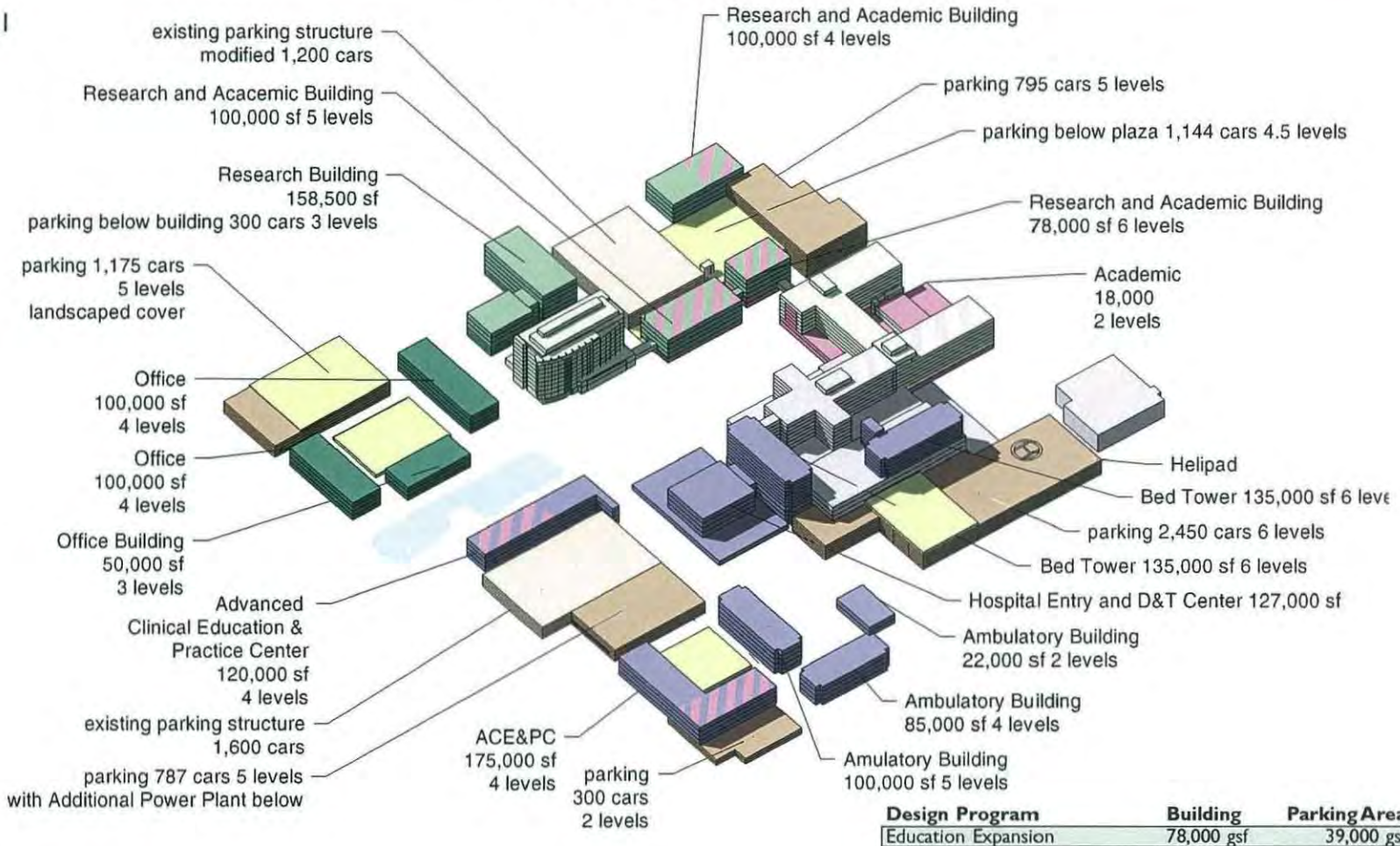
- Power Plant
  20,000 SF below parking structure
- Parking Structure A
  787 cars on 5 levels
- Advanced Clinical Education & Practice Center
  120,000 GSF on 4 levels
- Advanced Clinical Education & Practice Center
  175,000 GSF on 4 levels
- Parking Structure B
  300 cars on 2 levels
- Ambulatory Building C
  205,000 GSF on 2, 4 and 5 levels

Southwest Quadrant

- Parking Structure
  1,175 cars on 5 levels
- Commonwealth Medicine Building A
  125,000 GSF on 5 levels
- Commonwealth Medicine Building B
  75,000 GSF on 4 levels
- Commonwealth Medicine Building C
  125,000 GSF on 5 levels

Area Tabulations

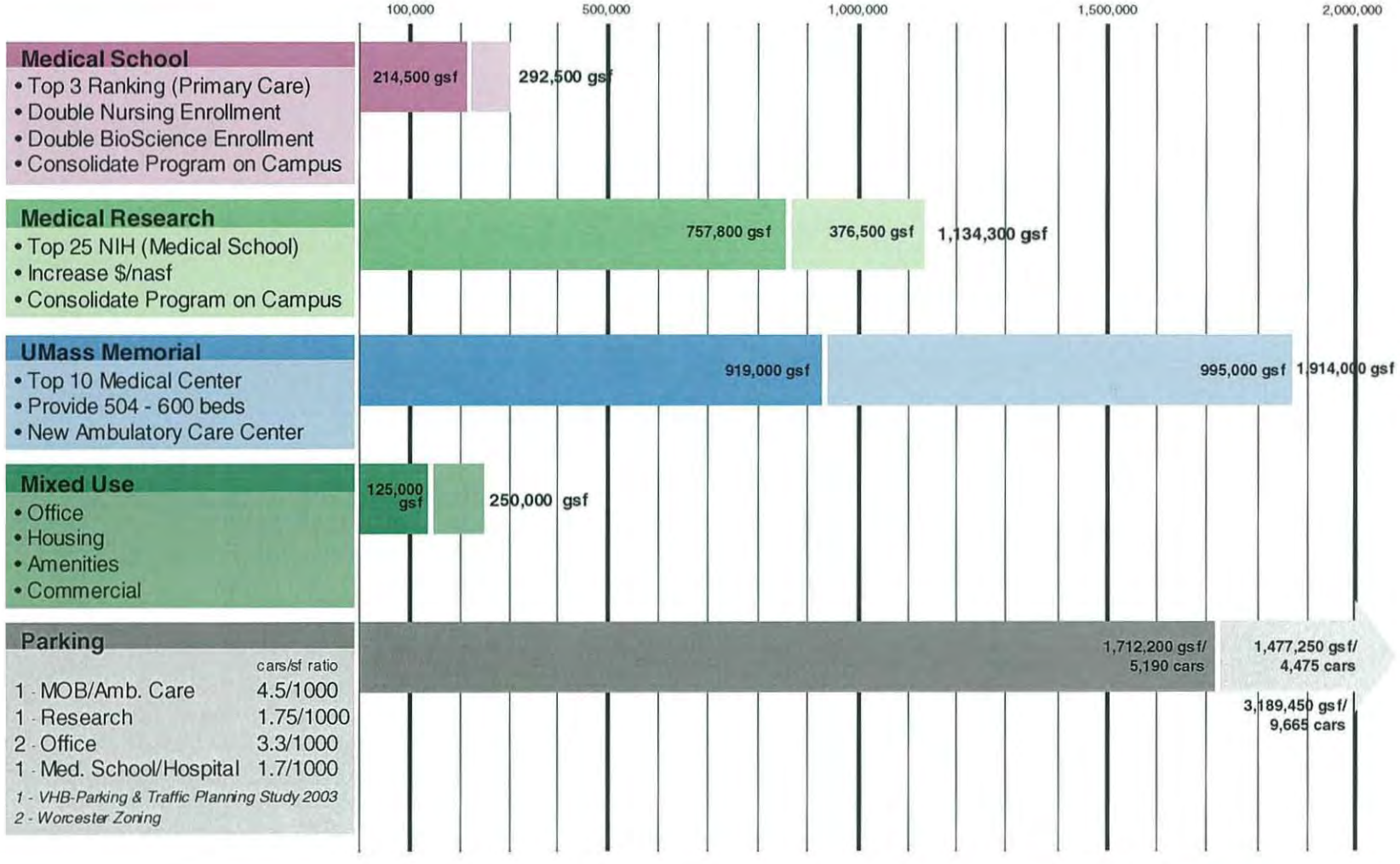
Figure VIII.1



Design Program	Building	Parking Area	Cars
Education Expansion	78,000 gsf	39,000 gsf	119
New Research Top 25	376,500 gsf	221,000 gsf	670
Hospital Expansion, *600 Beds*	*270,000 gsf*	*152,000 gsf*	*460*
Hospital Expansion, *Support*	*225,000 gsf*	*126,000 gsf*	*383*
Clinical Education & Practice	500,000 gsf	660,000 gsf	2,000
Mixed Use/Commonwealth Med.	250,000 gsf	272,000 gsf	825

"What If" Space Projections

Figure VIII.2



TSOI / KOBUS & ASSOCIATES

ARCHITECTS

University of Massachusetts Medical School

Section IX. Civil Site Plan

UNIVERSITY OF MASSACHUSETTS MEDICAL SCHOOL
MASTER PLAN SITE CIVIL UTILITY SYSTEM STUDY REPORT

SITE LOCATION AND SITE CONDITIONS

The University of Massachusetts Medical School site is located along Route 9 in the eastern part of Worcester, Massachusetts. The study site is bounded by Plantation Street on the west, North Road on the north, Lake Avenue North on the east and Belmont Street (Route 9) on the south. Within the site, the Medical School building is situated to the north adjacent to North Road and to the center between Lake Avenue North and Plantation Street. The study site is also home to the Memorial Hospital, which the Medical School is affiliated with and is located to the immediate south on the eastern half of the site. A research facility (Lazare Research Building) that is affiliated with the School has a building facility slightly south and west of the School. Two structured parking garages serve the site, one towards the northwest portion of the site and the other on the south central area of the site. A power plant that serves the site is located on the northeast corner of the site. The Department of Youth Services (DYS) maintains a facility on the site adjacent to Belmont Street and west of the structured garage. The Massachusetts Highway Department facility is in this area east of the parking garage.

The main access to the site is through South Street, which traverses the site from Plantation Street to Lake Avenue North. South Street is at about the mid point of Plantation Avenue, south of Lazare Building and the Hospital. It runs in an easterly direction and beyond the Hospital it turns towards the northeast and continues until it intersects Lake Avenue North. Two minor access roads from North Road on both sides of the Medical School and the Hospital intersect South Road.

Our study is based on existing information (plans and other documents) provided by the Medical School, supplemented by plans and other information obtained from the City of Worcester, along with the development scheme provided by Tsoi/Kobus & Associates. We have examined all available information at our disposal and have studied the development scheme that has been provided to formulate the Site Civil Utilities System Plan alternative presented below.

STORMWATER DRAIN SYSTEM

The site contains approximately 80 acres; except for a 10 acre ± area in the southwest corner of the site and an area (3 acre ±) in the central portion of the site between the Hospital on east, and northwest garage and the Lazare Research Building on the west, the remainder of the site is either occupied by buildings, paved roadways or paved at-grade parking areas. The highest elevation on site of approximately 498 feet is at the southwest corner of the site and slopes generally towards the northeast. Most of the runoff from this southwest section of the site is intercepted by a swale that is located just east of the DYS facility and discharges into a small wetland area abutting Belmont Street. Stormwater runoff for the rest of the site is collected by catch basins and is transported to stormwater conduits that ultimately convey the runoff to a stormwater structure at the intersection of North Road and Lake Avenue North.

The proposed development under the Master Plan would have no impact on off-site drainage patterns, as most of the proposed development is entirely within previously developed areas. Some the areas that were previously impervious would be landscaped under the Master Plan. The internal site drainage would be impacted as a result of the drain line relocations that are required to accommodate the new building proposed under the Master Plan. Stormwater mitigation measures are proposed under the Master Plan drainage scheme to accommodate NPDES Construction Stormwater Management Notice of Intent permit requirements and the Commonwealth of Massachusetts Stormwater Management Policy. Three below grade groundwater recharge/ detention basins and one above grade retention/detention basin are proposed at locations shown on the attached Site Civil Utilities System Plan – Scheme 2, dated February 25, 2005. In developing the Scheme, we made every effort to avoid major drainage line relocations. No major relocation is proposed, except for a section of the existing 60-inch drainage pipe that may require relocation, if the design of the parking garage proposed south of the Power Plant cannot accommodate the drain line within the garage footprint. The proposed drainage system is shown in bold, solid green on the Site Civil Utilities System Plan.

Based on the limited available soil data, it is our engineering judgment that the site underlying soil is glacial till (group D soil) overlaid by a variable layer of fill. It is our opinion based on the above that groundwater recharge would not mandated by the Stormwater Management Policy. Group D soil is exempt from the groundwater recharge requirements under performance standards of the Policy. The Stormwater Management Policy did not prescribe any set of performance standards for projects such as proposed on the Master Plan. The Master Plan drainage scheme has incorporated possible mitigation measures; the extent to which it is implemented would be based on what the Medical School proposes during the implementation phase and what the City of Worcester Conservation Commission would approve.

SANITARY SEWER SYSTEM

Almost all the existing sanitary system on the Master Plan site is located on the northern half of the site and conveys the sanitary flows generated at the site to an existing 42-inch sewer in Lake Avenue North. The location of some of the proposed structures on this section of the site would require relocation of segments of the existing sewer lines as shown on the Site Civil Utilities System Plan. A new sanitary line is proposed along South Road to serve the new buildings on the southern portion of the Site that are shown on the Master Plan. The new sewer would convey the generated sanitary flows eastward to the above noted existing 42-inch sewer along Lake Avenue North. Our discussions with the City of Worcester did not reveal any capacity problems, and there are no plans in the near future for upgrades of the municipal facilities in the project area. Proposed relocations and new sewer lines are shown in bold, solid purple on the attached Utilities System Plan.

WATER DISTRIBUTION SYSTEM

Based on our review of the available hydrant fire flow test results and discussions with the City of Worcester, adequate water supply is available from the municipality to serve the proposed Master Plan development. Fire Pumps may be required for some of the proposed buildings to provide the required sprinkler system and dry standpipe system pressures. To accommodate the new buildings proposed for the Master Plan, we have retained as much of the existing water distribution system, as possible while expanding and upgrading the water distribution network. The proposed sections of the new water distribution network are shown in bold, solid blue on the Utilities System Plan.

×	UNKNOWN	⊖	STREET SIGN
⌀	UTILITY POLE	○	POST
☼	LIGHT POLE	○	MANHOLE
⊞	CATCH BASIN	⌑	TOWER
⊕	FIRE HYDRANT	⊙	TREE
-----	PARKING LOT	——	CHAIN LINK FENCE
——	PROPERTY LINE		
	UMass Property		
	Non-UMass Property		

NOTE:
NO PROPERTY LINE SURVEY MADE AT THIS TIME, INFORMATION SHOWN HEREON IS BASED UPON A COMPILATION OF DEEDS AND PLANS RECORDED AT THE WORCESTER DISTRICT REGISTRY OF DEEDS.

UNIVERSITY OF MASSACHUSETTS MEDICAL SCHOOL
MASTER PLAN SITE UTILITIES SYSTEM PLAN

DIVISION OF CAPITAL ASSET MANAGEMENT
MASSACHUSETTS STATE PROJECT NO. UMW 0301 CONTRACT ST1

SITE CIVIL UTILITIES
SYSTEMS PLAN – SCHEME 2

BRYANT Associates
Civil and Structural Engineering
Surveying
Landscape Architecture
Construction Management

DESIGNED BY: BDN/CCO	SCALE: 1"=80'	BA JOB 404009	
DRAWN BY: BDN			
CHECKED BY: CCO	DATE: DECEMBER 10, 2004		C-1
APPROVED BY: CCO	CONTRACT NO. ST1		
APPROVED BY:			

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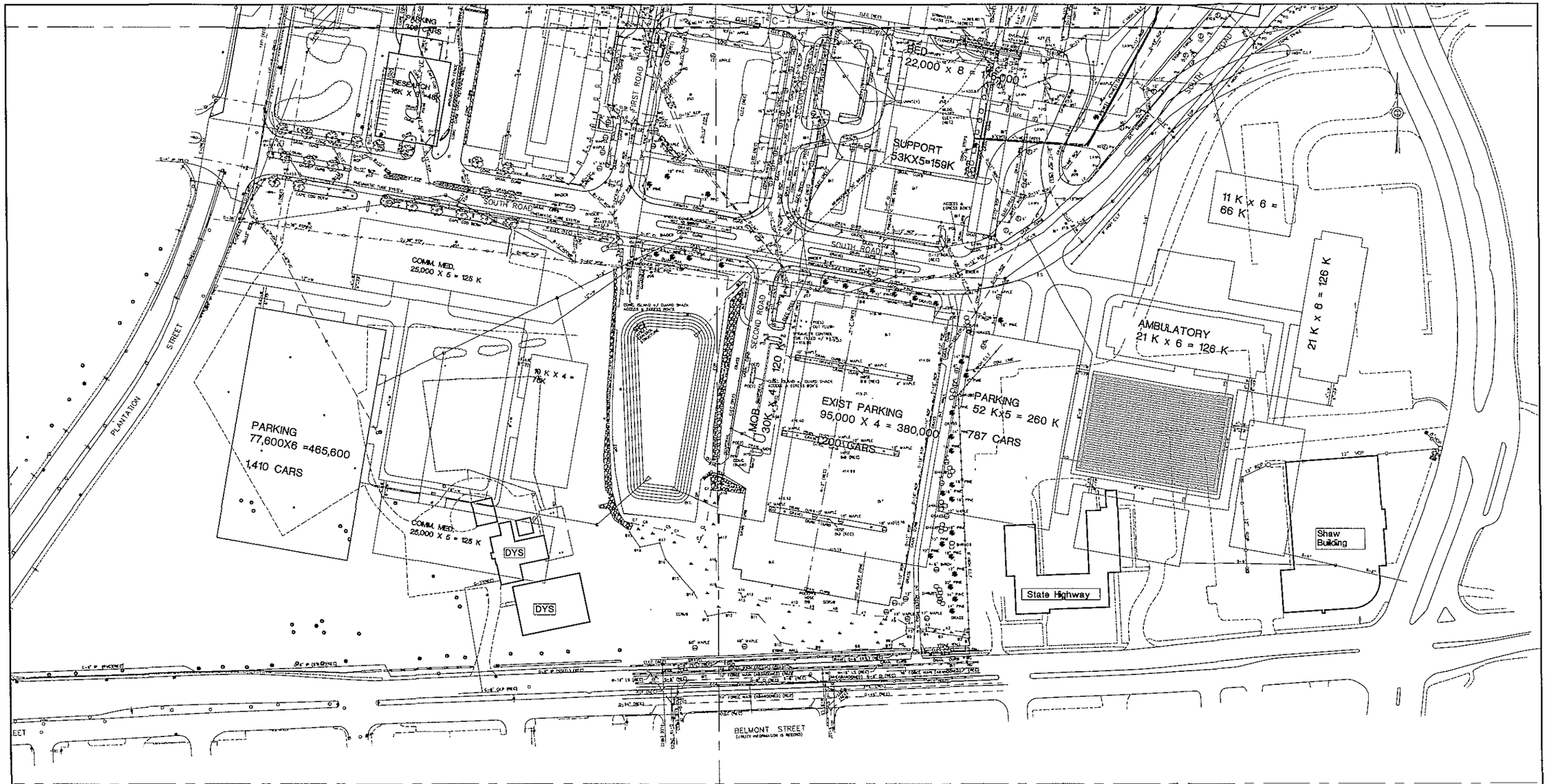

LEGEND

- PROPOSE SANITARY SEWER
- PROPOSE DRAINAGE SEWER
- PROPOSE DETENTION SYSTEM
- PROPOSE WATER SYSTEM
- ARMOR

RAS	REMOVE AND RESET
ABD	ABANDON
SMH	SEWER MANHOLE
DMH	DRAIN MANHOLE
D	DRAINAGE
S	SEWER
W	WATER
CB	CATCH BASIN
RD	ROOF DRAIN
FP	FIRE PROTECTION
CTC	CONNECT TO EXISTING
●	PROPOSE DMH
●	PROPOSE SMH

×	UNKNOWN	—o—	STREET SIGN
☼	UTILITY POLE	○	POST
☼	LIGHT POLE	○	MANHOLE
⊞	CATCH BASIN	⌑	TOWER
⚷	FIRE HYDRANT	⊙	TREE
----	PARKING LOT	——	CHAIN LINK FENCE
———	PROPERTY LINE		
	UMass Property		
	Non-UMass Property		

NOTE:

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UNIVERSITY OF MASSACHUSETTS MEDICAL SCHOOL
MASTER PLAN SITE UTILITIES SYSTEM PLAN

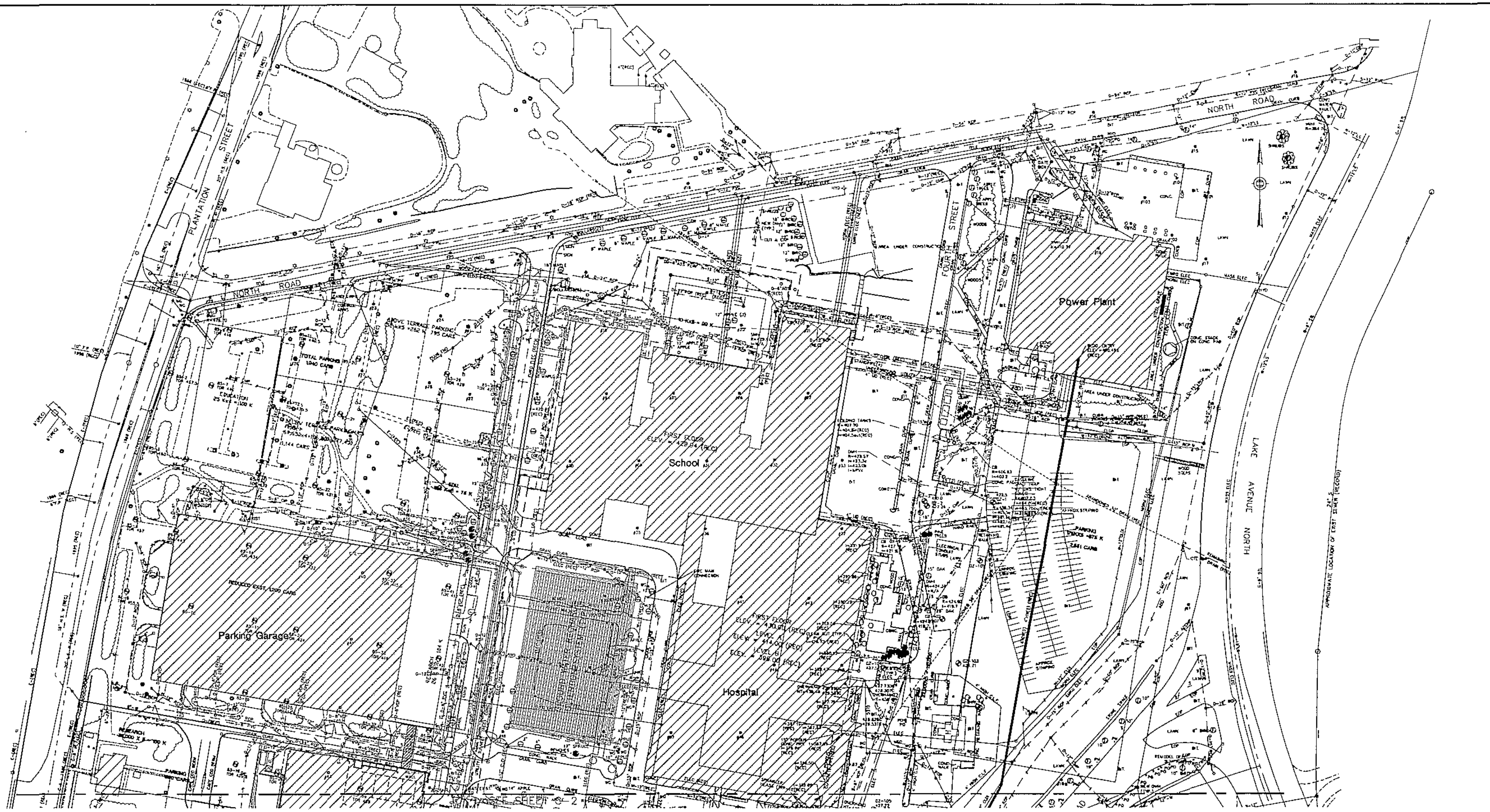
DIVISION OF CAPITAL ASSET MANAGEMENT
MASSACHUSETTS STATE PROJECT NO. UMW 0301 CONTRACT ST1

SITE CIVIL UTILITIES
SYSTEMS PLAN - SCHEME 2

BRYANT Associates
Civil and Structural Engineering
Surveying
Landscape Architecture
Construction Management
120 Boylston Street, Boston, MA

DESIGNED BY: BDN/CCO	SCALE: 1"=60'	BAI JOB #04009	
DRAWN BY: BDN			C-2
CHECKED BY: CCO	DATE: DECEMBER 10, 2004		
APPROVED BY: CCO	CONTRACT NO.: ST1		

APPROVED BY:



REPLICATE WETLAND
PROPOSE SANITARY SEWER
PROPOSE DRAINAGE SEWER
PROPOSE DETENTION SYSTEM
PROPOSE WATER SYSTEM
ABANDON

R&S	REMOVE AND RESET
ABD	ABANDON
SMH	SEWER MANHOLE
DMH	DRAIN MANHOLE
D	DRAINAGE
S	SEWER
W	WATER
CB	CATCH BASIN
RD	ROOF DRAIN
FP	FIRE PRESSURE
CTE	CONNECT TO EXISTING
●	PROPOSE DMH
●	PROPOSE SMH
▫	CATCH BASIN
	TEST PITS
	CUT & CAP

NOTE:
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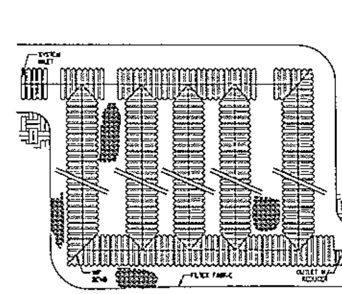
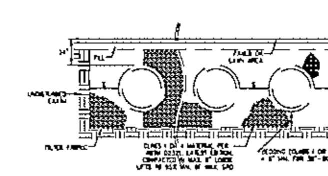
LEGEND

×	UNKNOWN		STREET SIGN
	UTILITY POLE		POST
	LIGHT POLE		MANHOLE
■	CATCH BASIN		TOWER
	FIRE HYDRANT		TREE
	PARKING LOT		CHAIN LINK FENCE
	PROPERTY LINE		DRAIN LINE
	WATER LINE		SEWER LINE
	ELECTRIC LINE		TELEPHONE LINE
REC	RECORD	UD	UNDERDRAIN SYSTEM
WG	WATER GATE	CONC	CONCRETE
BIT	BITUMINOUS	PVC	POLYVINYLCHLORIDE PIPE
CLF	CHAIN LINK FENCE	WSO	WATER SHUT OFF
HYD	HYDRANT	RCP	REINFORCED CONCRETE PIPE
R	RIM	EOP	EDGE OF PAVEMENT
I	INVERT	S	SIGN
GRAN	GRANITE	HW	HOT WATER
G	GAS	CW	COLD WATER
W/	WITH	STL	STEEL



TYPICAL SUBSURFACE DETENTION/GROUND WATER RECHARGE SYSTEM CROSS SECTION



TYPICAL SUBSURFACE DETENTION/GROUND WATER RECHARGE SYSTEM CROSS SECTION

UNIVERSITY OF MASSACHUSETTS MEDICAL SCHOOL MASTER PLAN SITE UTILITIES SYSTEM PLAN	
DIVISION OF CAPITAL ASSET MANAGEMENT MASSACHUSETTS STATE PROJECT NO. UMW 0301 CONTRACT ST1	
SITE CIVIL UTILITIES SYSTEMS PLAN – SCHEME 3	
BRYANT Associates	Civil and Structural Engineering Surveying Landscape Architecture Construction Management
DESIGNED BY: BDN/CCO	SCALE: 1"=60'
DRAWN BY: BDN	BAI JOB #04009
CHECKED BY: CCO	DATE: FEBRUARY 25, 2005
APPROVED BY: CCO	CONTRACT NO. ST1
APPROVED BY:	C–1

REPLICATE WETLAND
PROPOSE SANITARY SEWER
PROPOSE DRAINAGE SEWER
PROPOSE DETENTION SYSTEM
PROPOSE WATER SYSTEM
ABANDON

RAS	REMOVE AND RESET
ABD	ABANDON
SMH	SEWER MANHOLE
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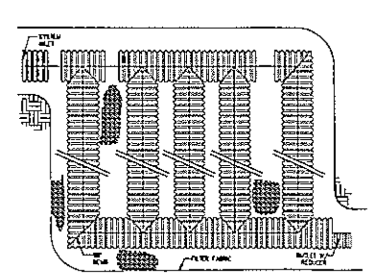
	TEST PITS
	CUT & CAP

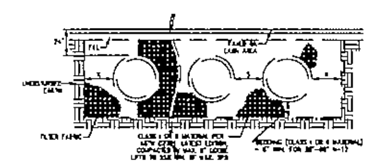
LEGEND

X	UNKNOWN		STREET SIGN
	UTILITY POLE		POST
	LIGHT POLE		MANHOLE
	CATCH BASIN		TOWER
	FIRE HYDRANT		TREE
	PARKING LOT		CHAIN LINK FENCE
	PROPERTY LINE		DRAIN LINE
	WATER LINE		SEWER LINE
	ELECTRIC LINE		TELEPHONE LINE
REC	RECORD	UD	UNDERDRAIN SYSTEM
WG	WATER GATE	CONC	CONCRETE
BIT.	BITUMINOUS	PVC	POLYVINYLCHLORIDE PIPE
CLF	CHAIN LINK FENCE	WSO	WATER SHUT OFF
HYD.	HYDRANT	RCP	REINFORCED CONCRETE PIPE
R	RIM	EOP	EDGE OF PAVEMENT
I	INVERT	S	SIGN
GRAN.	GRANITE	HW	HOT WATER
G	GAS	CW	COLD WATER
W/	WITH	STL	STEEL

NOTE:
NO PROPERTY LINE SURVEY MADE AT THIS TIME. INFORMATION SHOWN HEREON IS BASED UPON A COMPILATION OF DEEDS AND PLANS RECORDED AT THE WORCESTER DISTRICT REGISTRY OF DEEDS.



TYPICAL SUBSURFACE DETENTION/GROUND WATER RECHARGE SYSTEM CROSS SECTION



TYPICAL SUBSURFACE DETENTION/GROUND WATER RECHARGE SYSTEM CROSS SECTION

UNIVERSITY OF MASSACHUSETTS MEDICAL SCHOOL
MASTER PLAN SITE UTILITIES SYSTEM PLAN

DIVISION OF CAPITAL ASSET MANAGEMENT
MASSACHUSETTS STATE PROJECT NO. UMW 0301 CONTRACT ST1

SITE CIVL UTILITIES
SYSTEMS PLAN – SCHEME 3

BRYANT Associates — Civil and Structural Engineering, Surveying, Landscape Architecture, Construction Management

DESIGNED BY: BDN/CCO	SCALE: 1"=60'		BAI JOB #04009
DRAWN BY: BDN			C-2
CHECKED BY: CCO	DATE: FEBRUARY 25, 2005		
APPROVED BY: CCO	CONTRACT NO. ST1		

APPROVED BY:

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TSOI / KOBUS & ASSOCIATES
ARCHITECTS

University of Massachusetts Medical School

Section X. Infrastructure Report and Plan

UTILITY INFRASTRUCTURE AND PRELIMINARY RECOMMENDATIONS TO ACCOMMODATE PROPOSED UMASS MEDICAL SCHOOL DEVELOPMENT

Executive Summary - Mechanical and Electrical Infrastructure

The following observations and recommendations regarding energy plant and utility distribution systems are made to accommodating expansion, reliability, energy and operating efficiencies and sustainability.

- Maintain and expand central utility system infrastructure as has been prudently operated and reliably served the campus, especially to complete in a carefully planned manner the radial loop upgrade of the distribution system for electric, chilled water, and steam such that distribution reliability and efficiency is brought to the highest practical level.

- Add critically needed redundancy to the electric and thermal energy supply system, ideally by the addition of a second central energy plant at the northwest corner of the site development area, or as a less desirable alternate, by a new bulk electric substation in lieu of an electric/thermal plant with allowances made for connection points and securing reliably pre-planned arrangements for portable equipment. In either case this new source would be tied into a redundant distribution system, and would especially address the undue concentration of utility electric power as is currently brought into a single switchgear room, either by relocating an existing feeder, or bringing in a new one.

- Consider as a prime mover option for an expanded existing or new redundant central energy plant 5 to 10 Megawatts of Combined Heat and Power gas turbine driven generator capacity, rather than the existing steam turbine topping cycle equipment, and add 10,000 tons of steam turbine or steam absorption chilling machines. This second power plant would operate in parallel with or independently of the existing power plant, and provide a physical separation of the utility electric power sources to bolster reliability. The two plant locations will also allow future capacity and energy technology modifications to occur more easily. As the existing central energy plant is "thermally rich" and requires the use of "firm" gas to achieve emissions permitting, electric generation via "electrically rich" gas turbine generators is recommended.

- Upon the activation of the new second plant flexibility will be created to accomplish seriously needed modernization of the existing power plant control systems, and present opportunity to consider the conversion of the capital intensive existing central plant steam cycle equipment to use biomass fuels, as well as to allow space for implementation of fuel cells (or alternative future generation hardware).

- The substantial amount of structured parking should be evaluated as a cost effective opportunity to include thermal storage to enable off-peak electricity to be utilized to created stored cooling, e.g. ice storage, as well as the potential benefit of the lakeside geography of the campus to utilize deep water from the lake as a stored cooling resource.

Overview

The Commonwealth of Massachusetts Division of Capital Asset Management (DCAM) and The University of Massachusetts Medical School (UMMS) have recognized the Worcester campus as a consequential and dynamic asset to the UMass educational system. This campus experiences a robust amount of medical as well as academic activity and is earmarked for significant investment and growth. As such, it is presently anticipated that an approximate 1,300,000 gross square feet (gsf) of new facilities as well as 1,000,000 gsf of structured parking will be added to this campus over a 20-year program.

UMMS has historically placed significant value on the benefits of high quality, and reliable campus utility systems. The existing campus facilities are served almost entirely by a well-conceived central utility distribution systems which provide for flexibility, relatively-low operating costs and a reasonable level of redundancy. However, the scale of the new Medical School campus development will necessitate substantial upgrades to the existing systems in order to accommodate the projected loads. Additionally, due to the scale of the going forward full development scenario of a virtual doubling of the built environment, UMMS and DCAM have recognized the importance of examining the opportunities to best serve the campus to meet two mutually important objectives, to reliably and adequately serve the utilities requirements and to also accomplish this in a cost effective and environmentally responsible manner.

While a central utility approach to serving infrastructure requires significant capital costs associated with the initial construction, a continued emphasis on central campus utility distribution will ultimately provide for the best life cycle costs. Additionally, the projected development and associated infrastructure requirements create opportunities to improve the reliability, operating costs and flexibility of the existing utility distribution systems. The following outlines the configuration, capacity and condition of existing systems on campus, along with projected loads and recommended utility infrastructure upgrades for the proposed Campus Development.

The actual loads developed will be influenced by the degree of energy conservation measures employed in the building designs. Reduced building loads can result in substantial cost savings for utility infrastructure systems. This issue would be an integral component of future space programming and life cycle decision-making as the new site building development is advanced. However for purposes of defining required infrastructure upgrades, a range of potential loads are identified here.

Master Plan Objectives and Recommendations

Expansion Accommodation: The master plan calls for nearly doubling the campus facility gross square footage. Services are required to meet the needs of roughly 4 million total square feet of buildings, up from a current inventory of roughly 2.3 million square feet. Perhaps the most immediate capacity concern is for the chilled water system for which current facility needs are approaching installed capacity requirements. Electricity redundancy and reliability is also a major immediate concern given that normal and emergency feeders distribute from a single location (without code compliant gear spacing). For all main utility services, a looped distribution is recommended. A second energy plant would also create the opportunity to revise the prime mover type (natural gas turbine/generator) to affect higher overall plant efficiency and electric to thermal balance.

Reliability: Critical care hospital and research/academic functions require a high degree of reliability for electrical, steam, and chilled water services. A second energy plant location with a looped distribution system would offer the opportunity for increased redundancy and reliability. The existing electrical distribution system has a single point of failure for electric power distribution, from both the utility and on-site generation perspectives. The existing electrical switchgear does not conform to modern codes with normal and emergency switchgear located in the same room at both the energy plant and building substations. Spacing between the plant normal and emergency switchgear does not meet current code requirements. There is also a single point of failure on the heating and cooling source and distribution.

Operational Issues: The campus has a requirement for 24/7, year-round utility operation. There is an inadequate source and distribution mix to enable major maintenance or modernization (e.g. obsolete power plant controls). Electrical and thermal energy production is not well balanced due to existing prime mover selections. The utility production does not match the building usage designs, thereby leading to inefficient plant operation (e.g. low chilled water delta T and 400 degree superheated 50 psi steam as heating medium).

Sustainability: Having a cogeneration plant on site is a good start. However a steam cycle prime mover does not allow a variety of fuel options given emissions constraints. This has pressed the plant to sign a "firm" gas contract. The plant production heating and cooling media should match the end use requirements for maximum plant efficiency. Demand side reduction through participation in LEED is highly recommended. Fuel mix on the supply side (e.g. biomass) may be allowed through the energy plant expansion. Thermal energy storage may be incorporated into parking garage construction. Lake source cooling is also a possibility.

Power Plant - Site Utility Plan Options

Reflecting the needs of providing reliable services to the campus, three major options have been studied regarding the implementation of pre-existing plans and new recommendations, as follows:

- General Recommendations – All Options

  Complete the conversion of all UMMS site distribution to radial loop redundant site distribution.

- Expand Existing Power Plant – Option A

  Provide a gas turbine and heat recovery steam generator (HRSG) expansion as a new wing to the existing power plant, with subsequent modernization of the existing old systems. Add a new bulk electric substation with a new Mass Electric utility power feeder. Develop a disaster plan, laydown areas and connection points for portable boilers and chillers as pre-planned emergency response in the event of a loss of the single power plant that serves the campus thermal requirements (reference Drawing SK-A).

- New Second Redundant Power Plant – Option B

  Provide a new redundant power plant at the northwest corner of the campus utilizing a gas turbine and heat recovery steam generator, with subsequent modernization of the existing power plant old systems. The second plant would be configured for natural gas as its primary fuel and the existing power plant would become a viable candidate for conversion to utilize biomass fuel (reference Drawing SK-B).

- Redundant Off Campus Satellite Plant – Option C

  In the event of a possible redevelopment of the former Worcester State Hospital (WSH) site as University residential or student dormitory facilities, include a new redundant power plant at WSH site with electric and thermal services interconnected to the UMMS campus. This plant would utilize gas turbine and heat recovery steam generator equipment and similar to Option B above, and would enable subsequent modernization of the existing UMMS power plant old systems. The second plant would be configured for natural gas as its primary fuel (reference Drawing SK-C).

Chilled Water System

Central Plant: The UMMS campus has a stand-alone central utility plant at the northeast corner of the campus. The plant was originally installed in the 1973. The chiller plant experienced a major upgrade in the year 2000. The plant presently contains 4 water-cooled centrifugal chillers. There are three 2,500 ton steam turbine driven centrifugal chillers that are original and over 30 years old, and one 5,000 ton steam turbine driven centrifugal chiller, which is roughly five years old. One of the three original 2,500 ton chillers has been retrofitted to use environmentally acceptable refrigerants. The other two original 2,500 ton chillers use R-11, are close to the end of their anticipated service life and their steam rates (#/ton-hour) are significantly higher than would be expected of a modern installation of chillers of this type. The newer 5,000 ton chiller uses environmentally acceptable refrigerant and is in excellent condition. Dedicated constant speed primary pumps are headered together. A bypass is installed to maintain a differential pressure setpoint across the plant chilled water supply and return headers. CHWP-1, 2,3,4 are 200 HP, rated for 3750 GPM at 76 psid (178 ft.), and are manufactured by Worthington. CHWP-5 is 250 HP, rated for 3750 GPM at 76 psid (178 ft.), and are manufactured by Ingersoll-Dresser. Cooling towers are located on the near the plant, they are in good condition, but there is no spare cooling tower capacity. The total plant capacity is 12,500 tons. The current peak-cooling load is roughly 10,000 tons (including 890 tons of expansion load coming on line as a result of the "clip-on" additions and Emergency Department Expansion), but poor chilled water delta T derates the available plant tonnage. Except for design (or near design conditions) one 2,500 ton chiller and auxiliaries are available for redundancy. It is possible to expand the plant capacity, but an addition to the building may be required. See below for additional capacity expansion options. Original chillers are designed for either 15 or 16 degrees F. delta T (CH-4 is 15), however flow rates indicate 2 gpm/ton or 12 degree delta T. It is recommended that the existing large chilled water coils located in the buildings be replaced with higher delta T coils, and that any new coils installed be designed for a 15 degree delta T or higher.

Existing Chilled Water Loads: The existing chilled water plant can barely meet today's demands under peak conditions. A previous Utilities Master Plan has developed a model of the campus chilled water use. Indeed, when other buildings are connected to the system, which are under construction or already have chilled water service available, the load may exceed the current installed plant and distribution capacity. With the limited redundancy, which will be available when existing projects come on line, it should be assumed that the plant in its present configuration has no excess capacity to support the any major proposed loads when they come on line. New loads on the campus would need to be served by a.) adding a new addition to the chiller building and new chiller and cooling tower capacity, b.) Building a satellite plant, or c.) building individual plants for each major expansion. Whatever expansion method is employed should be designed to insure enough backup capacity to withstand the loss of the largest machine.

Chilled Water Distribution: The chilled water distribution system has a single set of major distribution mains (30") extending west and south from the plant to the Hospital. If the load grows significantly, the distribution will be overloaded. Serious consideration should be given to measures, proposed from prior work invested in examining the building cooling systems to increase the temperature differential between supply and return, as the existing conditions result in much of the existing systems operating at a now obsolete condition of almost 2 gallons per minute (gpm) versus the modern day efforts to achieve flows 25% or more below these levels. This will drastically increase capacity of existing site distribution chilled water piping to yield a considerable avoided new capital cost, as well as reduce pumping power and collateral heat gain to yield an operating and life cycle cost benefit.

Preliminary Chilled Water System Recommendations: Projected additional cooling loads for the complete UMMS Campus Development are in the range of 10,000 tons, depending on option, program requirements and extent of building energy conservation features.

We recommend adding the required additional cooling capacity in the form of steam-turbine driven centrifugal chillers with surface condensers or two stage steam-motivated absorption chillers to be located in a satellite energy plant located at the northwest corner of the site, or by expansion of the existing power plant.

The loop distribution concept proposed by the R.G. Vanderweil Hydraulic Study dated September 17, 2003 remains valid. However, some of the loop segment pipe sizes may need to be revised to support the suggested addition of increased chiller capacity as part of an expanded existing or new second central plant.

Steam System

Steam Plant: The campus steam distribution system provides steam to satisfy essentially all of the heating and domestic water loads for buildings on campus as well as steam for electric generation. Steam is produced in a central boiler plant with four steam boilers located at the central utility plant at the northeast corner of the campus. The boiler plant portion of the central utility plant was constructed in 1973. Two of the steam boilers are original and produce steam at 250 psig. These are Boilers B-1 and B-2 each with a capacity of 115,000 #/hr. Two steam boilers were installed in or around 1998 and produce superheated steam at 1100 psig. These are Boilers B-3 and B-4 each with a capacity of 115,000

#/hr. The boiler plant operates continuously. An additional 50 psig steam source is currently being contemplated as well as a steam distribution expansion.

Existing Steam Loads: Campus steam loads have been reduced somewhat in the past few years due to energy efficiency measures implemented in many of the campus buildings. However, new development underway will result in peak loads approaching 170,000 lbs/hr under design conditions. This is the maximum load which can be handled by the high-pressure boilers during normal operation is 230,000 lbs/hr. The two original boilers can continue to provide reasonably effective back-up service, but should not be called into regular service in the intermediate to long term due to their age, condition and low operating efficiency. As such, it should be considered that the steam plant as it presently exists has limited excess capacity to accommodate new steam loads associated with the UMMS campus development.

Steam Distribution: Medium-pressure steam leaves the plant to service campus heating and domestic hot water loads via two paralleled steam mains (One 12" and one 8"). A study underway currently indicates adding and looping a new 16" medium pressure main and upsizing the existing 8" main to 12".

Most of the steam distribution systems are in tunnels or trench construction, and each tunnel contains the corresponding condensate return lines. The majority of the steam mains were installed in the early 1970's but has been well maintained over the years. The steam mains are considered to be in good condition and the condensate lines fair.

Preliminary Steam System Recommendations: Projected steam loads for the full Science Center development are in the range of 325,000 lbs/hr, depending on option, program requirements and extent of energy conservation measures employed.

New loads on the campus would need to be served by a.) adding a new addition to the boiler plant and new boiler and steam main capacity, b.) Building a satellite plant, or c.) building individual plants for each major expansion. Whatever expansion method is employed should be designed to insure enough backup capacity to withstand the loss of the largest boiler.

The full UMMS campus development proposed loads under any of the options would overtax the existing steam mains from the plant.

We recommend adding required additional heating capacity in a satellite energy plant located at the northwest corner of the site, or by expansion of the existing power plant.

The loop distribution concept proposed by the R.G. Vanderweil Hydraulic Study dated September 17, 2003 remains valid. However, some of the loop segment pipe sizes may need to be revised to support the suggested addition of increased chiller capacity as part of an expanded existing or new second central plant.

Electrical Service and Cogeneration

Main Service and Central Power Plant: The Utility service is primary metered at 13.8 kV (13,800 volts) and is presently served from three 13.8 kV dedicated feeders from two Massachusetts Electric Company (MECO) substations, the Shrewsbury Substation and the Bloomingdale Substation. The Utility company 13.8 kV feeders #1324 & #1325 can be fed from either of the two MECO substations. The third Utility feeder # 1323 is fed from Shrewsbury Substation only. The three 13.8 kV Utility feeders enter the UMASS Central Plant underground and serve the UMASS MC owned two primary selective 2000 A., 13.8 kV double ended Normal Power Switchgear lineup located in the Electrical Room in Central Plant. The Utility first Feeder (#1324) has a capacity of 13.15 MVA and serves the Left Lineup, the second Feeder (#1323) has a capacity of 8.96 MVA and serves the Right Lineup, and the third Feeder (#1325) is common and serves both lineups. The third feeder is used as a standby feeder and has a capacity of 13.15 MVA. Assuming that only one Utility will fail at a time, the available capacity of the three Utility feeders is 22.11 MVA. Per Utility Company records for last 12 months the maximum demand on Normal Power At the Medical Center was 10.46 MVA during the month of April-May, 2004. Power Factor (PF) correction capacitors have been provided at 13.8 kV to maintain PF above 0.9.

The Central Plant also contains three-cogeneration machines, which generate electricity on-site. The two units (with 250 psi steam turbines) have 2500 kW 4160V synchronous generators, and one unit (with 1100 psi steam driven turbine) has a 5000 kW 13.8 kV synchronous generator. The voltage of the 4160V generators is stepped up to 13.8 kV through two 3000/3750 kVA (AA/FA) transformers. The three generators are connected in parallel at 13.8 kV and provide standby/ emergency power to Medical School, Lazar Research, Central Plant, and Hospital. One of the cogeneration equipment is reserved as standby/ redundant unit. Maximum electric generation is, therefore, is limited to 5 MW. The Paralleling and Emergency (Standby) Power Distribution provides standby power to most of the loads in the Medical center, and is also connected to both Normal Power Switchgear through two feeders.

The paralleling and Emergency Power Distribution MV Switchgear along with the two 4160V to 13.8 kV transformer are also located in same Electric Room as for Normal Power (Utility) MV Switchgear. The distance between the Normal Power MV Switchgear and the Emergency Power Distribution MV Switchgear is only 4 feet. Per NEC, minimum-working distance between the two switchgears should be 6 feet. Moreover, the present code also requires 2-hour fire separation between the normal power and emergency power switchgear.

The Normal Power MV Switchgear is approximately 35 years old and is in satisfactory condition, but would need replacement on the basis of age in next 5 to 10 years. Similarly, the two 2500 kW co-generation plants and it's Switchgear is more than 30 years old and are approaching their end of useful life. The 5000 kW cogeneration unit was installed in 2000 and is in satisfactory condition.

Primary Electrical Distribution:

Primary Distribution System: 14 Radial feeders from the Normal Power MV Switchgear and 11 radial feeders from Paralleling and Emergency distribution Switchgear run underground/ in tunnel to serve the various substations/ and electric loads at Medical School, Lazare Research facility, Benedict Building, Central Power Plant, and UMASS Hospital. All substations, except at Benedict Building is served by two radial feeders in primary selective configuration. Details of substations at above buildings are described below:

Medical School: It has six double-ended 2500 kVA substations. Two radial feeders from Central Plant serve the primary of each transformer in a primary selective configuration. One of the radial feeders originates from the Normal Power Switchgear and the other from the Emergency (Standby) Power Switchgear. Thus, all the substations can be connected to Emergency power switchgear. The secondary of each dual ended substation is connected in automatic throw over Main-Tie-Main configuration. The dual primary selection radial distribution system provides the highest degree of reliability and flexibility. The existing system configuration also provides 100% redundancy, as long as load on each double-ended substation is monitored and kept below or equal to the capacity of one of its transformer.

Lazare Research Building: It has one double-ended 2500 kVA substation and one single ended 2000 kVA substation. Two radial feeders from Central Plant serve the primary of each transformer in a primary selective configuration. For the double-ended substation, both of the radial feeders originate from Normal Power Switchgear. The secondary of the dual ended substation is also connected in automatic throw over Main-Tie-Main configuration. The single ended substation is served by a single radial feeder, which originates from the Emergency (Standby) Power Switchgear. The existing system configuration is very flexible and reliable.

Hospital: It has two 2000 kVA double-ended substations, one 1500 kVA double-ended substation, and one 500 kVA single-ended substation. Two radial feeders from Central Plant serve the primary of each transformer in a primary selective configuration. For the 500 kVA single-ended substation, one of the radial feeders originates from the Normal Power Switchgear and the other from the Emergency (Standby) Power Switchgear. For both 2000 kVA double-ended substation, both of the radial feeders originate from Normal Power Switchgear, and for the 1500 double-ended substation, both of the radial feeders originate from Emergency (Standby) Power Switchgear. The secondary of each dual ended substation is connected in automatic throw over Main-Tie-Main configuration. The dual primary selection radial distribution system provides the highest degree of reliability and flexibility. The existing system configuration also provides 100% redundancy, as long as load on each double-ended substation is monitored and kept below or equal to the capacity of one of its transformers.

Central Plant: It has two double-ended 2500 kVA substations. Two radial feeders from Central Plant serve the primary of each transformer in a primary selective configuration. One of the radial feeders originates from the Normal Power Switchgear and the other from the Emergency (Standby) Power Switchgear. Thus, all the substations can be connected to Emergency power switchgear. The secondary of each dual ended substation is connected in automatic throw over Main-Tie-Main configuration. The dual primary selection radial distribution system provides the highest degree of reliability and flexibility. The existing system configuration also provides 100% redundancy, as long as load on each double-ended substation is monitored and kept below or equal to the capacity of one of its transformer. In addition to

this, power has two standby diesel generators: a 565 kW for essential loads and a 1400 kW set for black start of co-generation units.

Benedict Building: It has one 1500 kVA single-ended substation and is served by one radial feeder originating from Emergency (Standby) Power Switchgear.

Preliminary Electrical System Recommendations:

We recommend that as a minimum a new electrical service be incorporated into the proposed Bulk Electric Substation, or a new Second Redundant Power Plant be added to avoid the existing single point of failure situation as presently exists. This new service would be configured with dual utility 13.8 KV feeders to provide additional campus redundant capacity of 13.15 MVA.
The new service would supply utility power to the campus or provide the interconnection point for the new cogenerators to the utility system. The proposed service/distribution system infrastructure oneline schematic is shown on the attached Sketch SKE-1.

The proposed distribution system would also consist of gas turbine cogenerators and diesel engine driven emergency generators. The diesel generators and distribution equipment will be located in a separate 2 hour rated code compliant space to alleviate the code issue in the existing Central Plant. The diesel generators would be able to provide life safety and critical system power within the mandated 10-second window to the entire facility, both new and existing loads. The diesels could also provide cold start power to the gas turbines in the event of a major utility outage such as the 2003 Eastern/Central U.S. blackout.

The existing electrical service will be undercapacity for the full Master Plan buildout on a fully redundant basis. As an alternate approach, this capacity issue could be addressed by increasing the 8.96 MVA utility feeder to 13.15 MVA which would then provide a redundant capacity of 26.3 MVA, which would meet the maximum buildout capacity estimated requirement (24 MVA).

However, this proposed distribution system located at the satellite plant also meets the capacity requirements and further improves overall campus reliability as a major catastrophic event at the existing power plant could leave the entire facility without any power, normal or emergency (or steam or chilled water) for an extended period.

Natural and local codes state additional distribution system requirements. The NEC (700.9.B) requires that wiring from an emergency source be kept entirely independent of all other wiring and equipment. NFPA 99 (4.4.2.2.4.1) reiterates this requirement for the life safety and critical branches of the emergency system. In addition, the NEC (517.30.C) requires the emergency wiring systems be kept independent of all other wiring (including the equipment system). Also, the MEC (700.9.D) adds the requirements for 2-hour fire separation of all emergency systems wiring and equipment. NFPA has issued a written interpretation of these requirements that states that all the emergency and non-emergency (standby) equipment protective devices must be kept separate from each other.

There is a question of interpretation because the codes do not directly address whether these requirements apply to only an individual building with its own emergency power source (generator) or to a campus facility with multiple buildings fed from a single generator plant.

Our initial interpretation was that each building service entrance fed from the generator plant would establish the emergency and standby/equipment power source and the separation would occur at that point. However, in discussions with NFPA to get their interpretation to this campus system application, they stated that complete separation of the emergency wiring from other systems (standby equipment and normal) must occur from the generator plant throughout the system.

This means that separate feeders, raceways, manholes, enclosures, etc., must be incorporated for the emergency system from the generator plant to the individual buildings. The standby equipment system wiring can be run in the same raceway system as the normal system wiring and the distribution equipment can be located either in the normal power room, in the emergency electrical room with sufficient separation from the emergency system equipment such that a failure will be unlikely to cause damage to the other system or in a separate room for standby equipment.

Our recommendation would be to locate the standby equipment system distribution equipment in separate rooms because this further isolates and protects the standby equipment from damage caused by a normal power equipment failure and the emergency system from a standby equipment system equipment failure.

To further enhance reliability of the electrical infrastructure throughout the entire campus, a third utility feeder would be brought into the new bulk substation or the new generation be fed into the normal power switchgear lineup, providing an N + 1 redundant capacity of 26.3 MVA. Each of the single ended and each of the double ended substations distributed throughout the electrical system would then be fed by a 13.8 kv feeder that originates at the new Satellite Plant switchgear and a second 13.8 kv feeder that originates at the existing Central Plant switchgear. The single ended substations would be provided with a selector switch to connect to the two (2) primary (13.8 kv) feeders.

The switching of all these substations from their preferred source to their backup or alternate source could be accomplished either manually or automatically. The preferred approach is an automatic throwover and monitoring system because the size and complexity of the electrical distribution system would make manual switching an arduous and time-consuming task. An alternate approach could be to switch manually but from one central location with electric operators on all switches. Either method will enable switching to be accomplished to de-energize a feeder, transformer, etc. so preventative maintenance can be performed.

Another benefit of this approach is that the substations can be connected to the new Satellite Plant switchgear as their preferred source to provide optimum economic performance from the gas turbine cogeneration system.

In addition to the primary feeder configuration described above, each of the new double-ended substations will be provided with an automatic throwover system on their secondary side to pickup the entire substation load in the event one of the primary feeders or transformers is lost.

A wind turbine is also recommended to provide a sustainable renewable energy source. The energy developed would be relatively small compared to the demands of the facility; hence, the wind turbine would function mainly as a demonstration unit. A wind turbine with a swept area of 25 ft. diameter would provide approximately 20,000 KWh/yr. at the UMMC site assuming a mounting elevation of 100 ft. The value/year of this power including the Renewable Energy Credits (REC's) could be as high as

$3,000 per year, resulting in a simple pay back of 6-10 years. Many sitting issues would need to be addressed in a more detailed future feasibility study.

TELECOMMUNICATION AND DATA

New cabling for voice, data, and CATV to feed the new areas of development would be configured similar to the redundant radial loop distribution as previously discussed for power and thermal services. All communications services would be provided most reliably with backup by using satellite hubs and automated switching equipment.

NATURAL GAS

Significant natural gas distribution exists which serves the central utility plant. New service will be required to support a satellite central utility plant.

DOMESTIC AND FIRE PROTECTION WATER

The UMASS Medical School campus has adequate service in terms of water supply. Water mains on and around campus are generously sized and exhibit excellent flow and pressure characteristics. These mains are expected to have adequate capacity to support the domestic and fire protection water needs of the proposed UMMS development.

Relative to providing a fire protection water supply, it would be necessary to support the specific residual pressure requirements of proposed new construction using booster pumps, typically provided at each of the buildings. However, a most economic strategy might prove to be using one or two centralized fire pump locations together with a dedicated to fire protection distribution loop.

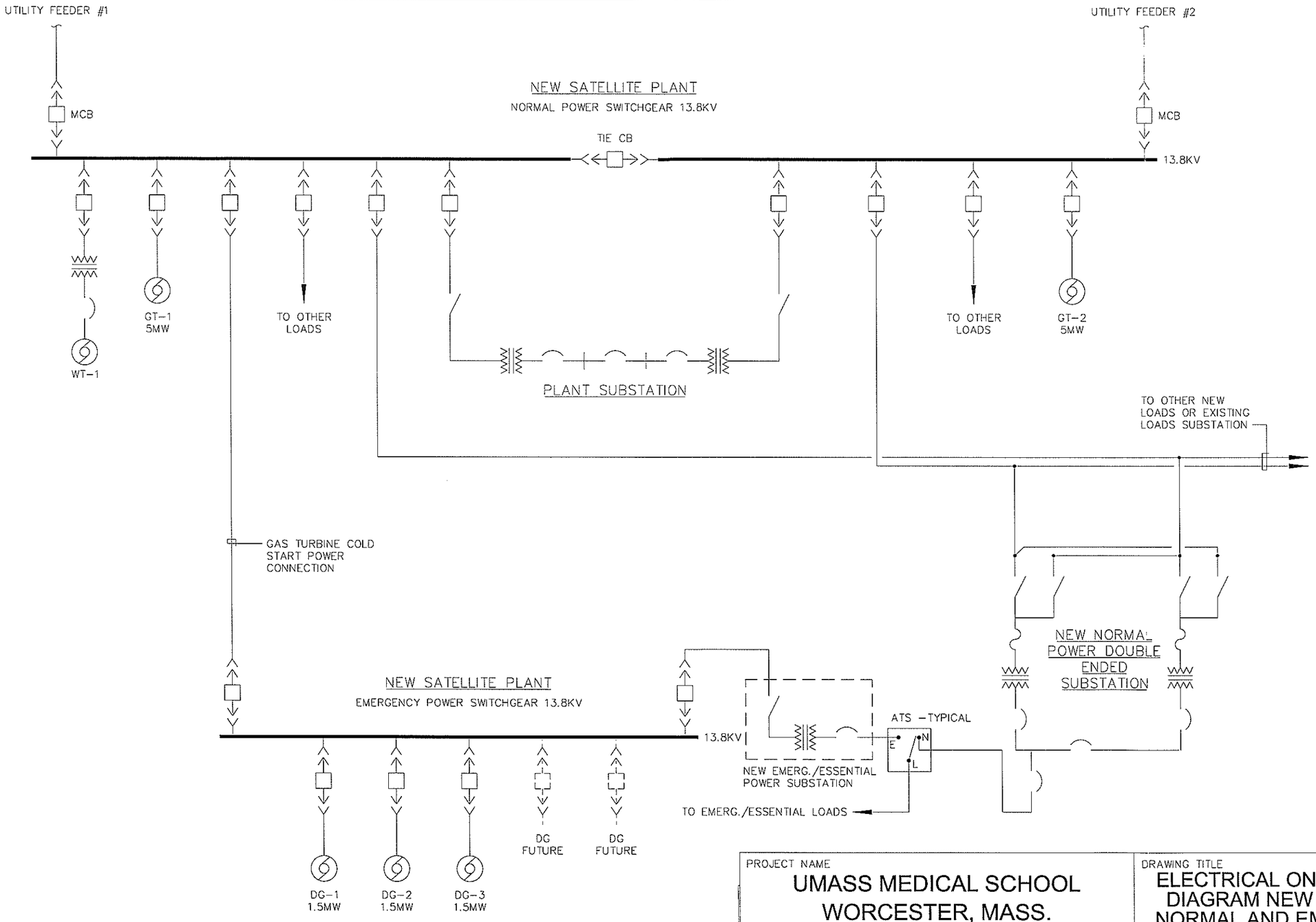
UMASS Medical School Master Plan
List of Report Drawings

SK – A Site Utilities Plan – Option A
Expand Existing Power Plant

SK – B Site Utilities Plan – Option B
New Second Redundant Power Plant

SK – C Site Utilities Plan – Option C
Redundant Off Campus Power Plant

SK – E1 Electrical One Line Schematic Diagram
New Satellite Plant Normal and Emergency Power



PROJECT NAME
UMASS MEDICAL SCHOOL
WORCESTER, MASS.

DRAWING TITLE
ELECTRICAL ONE-LINE SCHEMATIC DIAGRAM NEW SATELLITE PLANT NORMAL AND EMERGENCY POWER

VANZELMHEYWOOD & SHADFORD INC
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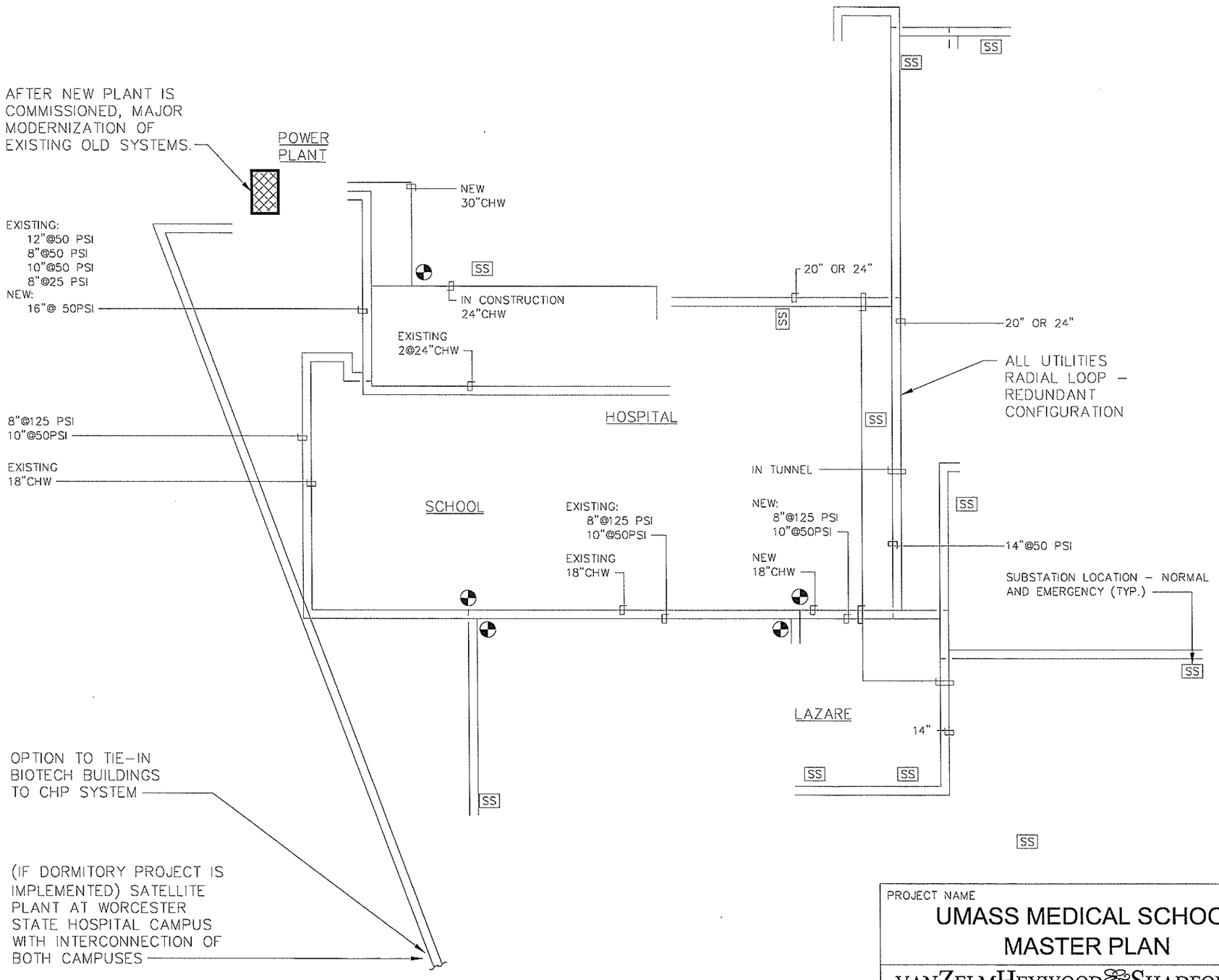
PROJECT NO.: 2004088.00
DRAWN BY: AKA
CHECKED BY: DGW
SCALE: NONE
DATE: 2/28/04

REMARKS:

SK- E1
DWG. NO.

File Path: P:\Umms\23024-00 Umms-Master Plan\Admin\Communications\Presentations\Final Master Report\Volume 3\Infrastructure Report\
File Name: 050228 UMMS Electrical One-Line (Options A-B-C).dwg Layout: SKE-1 April 12, 2005 - 10:55 AM User: mam



PROJECT NAME

UMASS MEDICAL SCHOOL MASTER PLAN

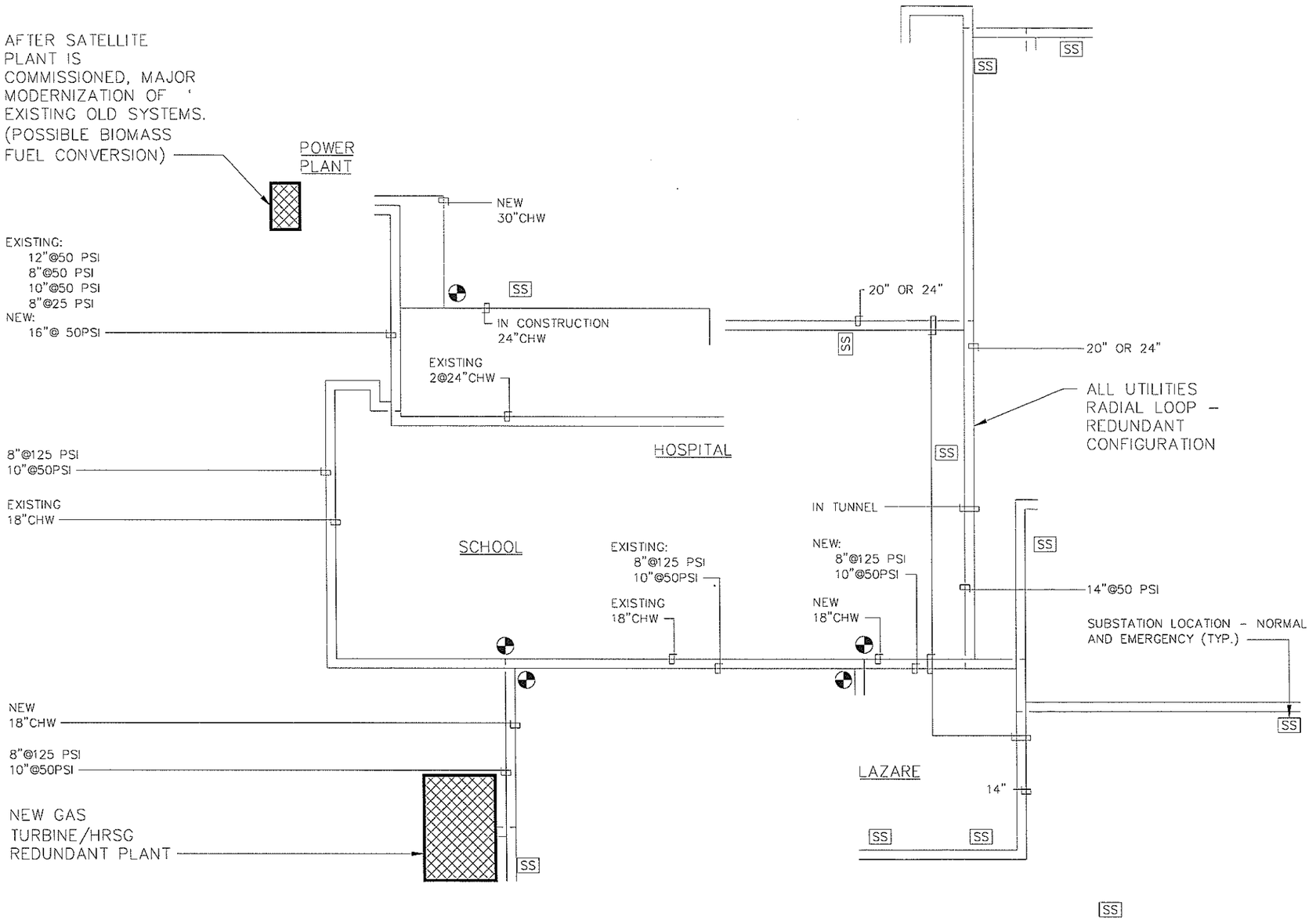
VANZELMHEYWOOD & SHADFORD INC
MECHANICAL AND ELECTRICAL ENGINEERS
29 SOUTH MAIN STREET WEST HARTFORD CT 06107-2420
(860) 521-4329 FAX (860) 521-5620

DRAWING TITLE

SITE UTILITIES PLAN - OPTION B REDUNDANT OFF CAMPUS SATELLITE PLANT

PROJECT NO.: 2004088.00			SK-C
DRAWN BY: JFC	CHECKED BY: RBR		
SCALE: 1" = 200'	DATE: 02/28/05		DWG. NO.

File Path: P:\Umms\23024-00 Umms-Master Plan\Admin\Communications\Presentations\Final Master Report\Volume 3\Infrastructure Report\
File Name: 050228 UMMS Site Utilities Plan (Options A-B-C).dwg Layout: SK-C April 12, 2005 - 10:58 AM User: mam



PROJECT NAME

UMASS MEDICAL SCHOOL MASTER PLAN

DRAWING TITLE

SITE UTILITIES PLAN - OPTION B NEW SECOND REDUNDANT POWER PLANT

VANZELMHEYWOOD & SHADFORD INC
MECHANICAL AND ELECTRICAL ENGINEERS
29 SOUTH MAIN STREET WEST HARTFORD CT 06107-2420
(860) 521-4329 FAX (860) 521-5620

PROJECT NO.: 2004088.00			SK-B
DRAWN BY: JFC	CHECKED BY: RBR		DWG. NO.
SCALE: 1" = 200'	DATE: 02/28/05		

File Path: P:\Umms\23024-00 Umms-Master Plan\Admin\Communications\Presentations\Final Master Report\Volume 3\Infrastructure Report\
File Name: 050228 UMMS Site Utilities Plan (Options A-B-C).dwg Layout: SK-B April 12, 2005 - 10:57 AM User: mam

GAS TURBINE/HRSG EXPANSION WITH FIRE WALL/DELUGE CURTAIN SEPARATION. (AFTER NEW IS COMMISSIONED, MAJOR MODERNIZATION OF EXISTING OLD SYSTEMS.

POWER PLANT

NEW 30"CHW

EXISTING:
12"@50 PSI
8"@50 PSI
10"@50 PSI
8"@25 PSI
NEW:
16"@ 50PSI

SS

IN CONSTRUCTION 24"CHW

EXISTING 2@24"CHW

DISASTER PLAN LAYDOWN AREA AND CONNECTION POINTS FOR PORTABLE BOILERS AND CHILLERS.

HOSPITAL

20" OR 24"

20" OR 24"

ALL UTILITIES RADIAL LOOP – REDUNDANT CONFIGURATION

IN TUNNEL

8"@125 PSI
10"@50PSI

EXISTING
18"CHW

SCHOOL

EXISTING:
8"@125 PSI
10"@50PSI

EXISTING
18"CHW

NEW:
8"@125 PSI
10"@50PSI

NEW
18"CHW

14"@50 PSI

SUBSTATION LOCATION – NORMAL AND EMERGENCY (TYP.)

NEW
18"CHW

8"@125 PSI
10"@50PSI

LAZARE

14"

BULK ELECTRIC SUBSTATION WITH NEW MASS ELECTRIC FEEDERS

N

PROJECT NAME
UMASS MEDICAL SCHOOL MASTER PLAN

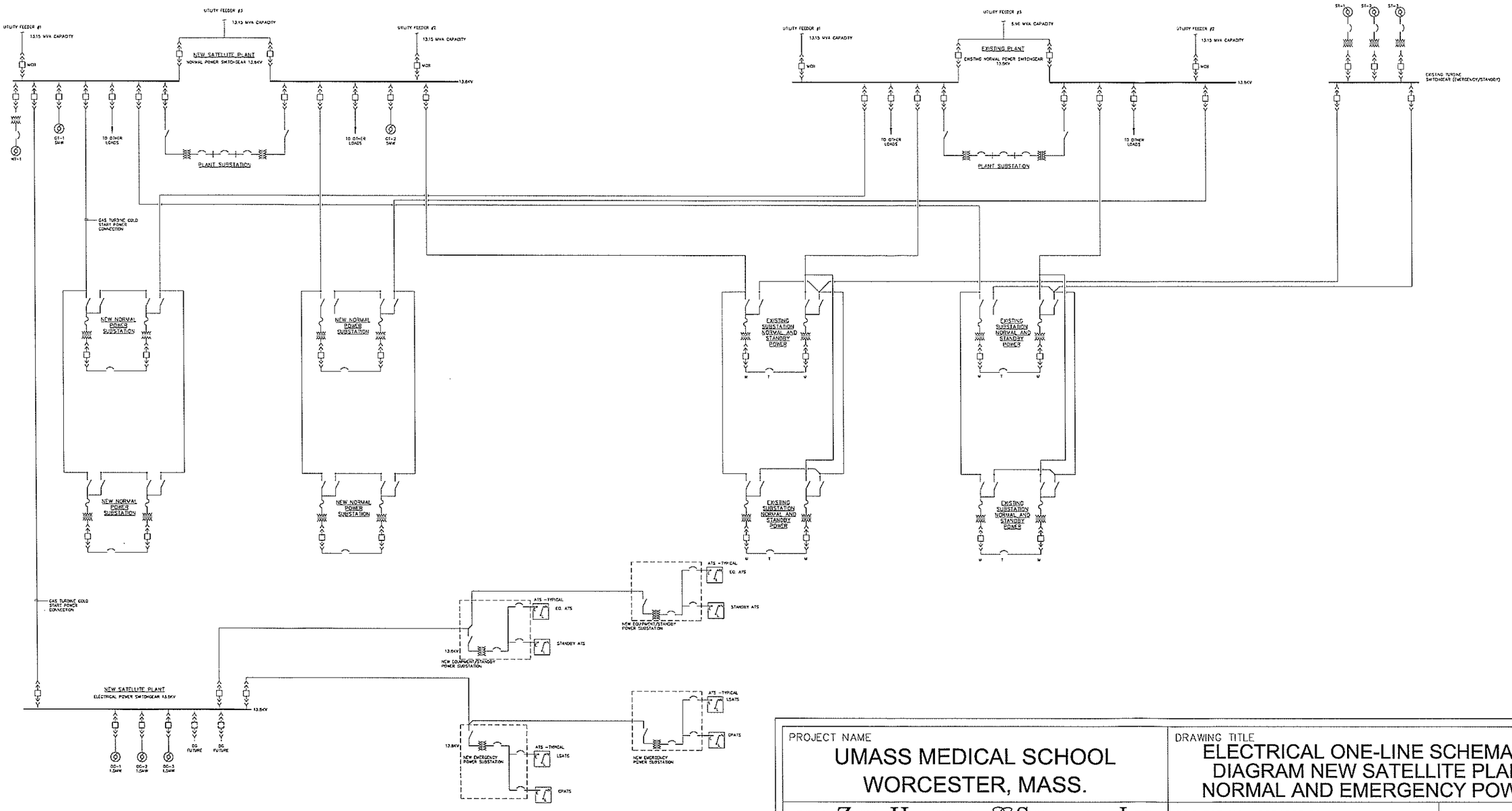
DRAWING TITLE
SITE UTILITIES PLAN - OPTION A
EXPAND EXISTING POWER PLANT

VANZELMHEYWOOD & SHADFORD INC
MECHANICAL AND ELECTRICAL ENGINEERS
29 SOUTH MAIN STREET WEST HARTFORD CT 06107-2420
(860) 521-4329 FAX (860) 521-5620

PROJECT NO.: 2004088.00
DRAWN BY: JFC
CHECKED BY: RBR
SCALE: 1" = 200'
DATE: 02/28/05

SK-A
DWG. NO.

File Path: P:\Umms\23024-00 Umms-Master Plan\Admin\Communications\Presentations\Final Master Report\Volume 3\Infrastructure Report\
File Name: 050228 UMMS Site Utilities Plan (Options A-B-C).dwg Layout: SK-A April 12, 2005 - 10:56 AM User: mam



PROJECT NAME

UMASS MEDICAL SCHOOL
WORCESTER, MASS.

VANZELMHEYWOOD&SHADFORDINC
MECHANICAL AND ELECTRICAL ENGINEERS
29 SOUTH MAIN STREET WEST HARTFORD CT 06107-2420
(860) 521-4329 FAX (860) 521-5620

DRAWING TITLE

ELECTRICAL ONE-LINE SCHEMATIC DIAGRAM NEW SATELLITE PLANT NORMAL AND EMERGENCY POWER

PROJECT NO.: 2004088.00

REVISION TO: N/A | REV.: N/A

SCALE: NTS | DATE: REVISED3/10/05

REMARKS:

SKE-1

DWG. NO.

File Path: P:\Umms\23024-00 Umms-Master Plan\Admin\Communications\Presentations\Final Master Report\Volume 3\Infrastructure Report\
File Name: E-1LIN.dwg Layout: 17x11 April 12, 2005 - 10:54 AM User: mam

TSOI / KOBUS & ASSOCIATES
ARCHITECTS

University of Massachusetts Medical School

Section XI. Traffic Study

UMass Medical School/ UMass Memorial Health Care System

Transportation Master Plan

Worcester, Massachusetts

Prepared for UMass Medical School/
UMass Memorial Heath Care System
55 Lake Avenue North
Worcester, MA 01655-0256

Prepared by ***VHB***/Vanasse Hangen Brustlin, Inc.
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617 924 1770

March 2005

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1

Introduction

This document presents a review, evaluation, and summary of the transportation issues surrounding the development of the University of Massachusetts Medical School/UMass Memorial Health Care System [UMMS/UMMHCS] campus located in Worcester, Massachusetts. This Transportation Plan component includes an analysis of the following on the UMMS/UMMHCS campus and within the project study area:

- existing and projected future vehicle traffic demands;
- existing and projected parking conditions on the campus;
- pedestrian and bicycle activity in and around the vicinity of the site; and
- public transportation and private shuttle bus activities.

The purposes of these analyses are to:

- define and quantify existing transportation conditions in the project study area;
- estimate the transportation impacts that would be generated under future conditions, based on the proposed UMMS/UMMHCS Master Plan projects; and
- develop a set of transportation improvement measures [both physical and non-physical] that would help to reduce the transportation impacts of future UMMS/UMMHCS patient and employment growth, as well as provide improvements to the future transportation infrastructure on and around the UMMS/UMMHCS campus.

This section provides a summary of the UMMS/UMMHCS project [as evaluated in this study], defines a study area for the project, and outlines the transportation access plan components. Subsequent sections provide a detailed discussion of methodology, analysis methods, existing conditions, and future conditions that are expected both with *and without* the UMMS/UMMHCS development project. Following these, the remainder of the document provides a detailed presentation of transportation mitigation and improvement actions that are proposed to reduce the anticipated impacts of the UMMS/UMMHCS project and provide transportation infrastructure improvements to the UMMS/UMMHCS campus as a whole.

Project Description

The project site is located on an approximately 76-acre parcel the northwesterly corner of Lake Avenue North and Belmont Street [Route 9] in Worcester. The site is bound by Lake Avenue North to the east; North Road to the north; Plantation Street to the west, and Belmont Street [Route 9] and South Road to the south. A site locus map is presented in Figure 1.

The UMMS/UMMHCS Master Plan proposal generally consists of 1,880,000 square feet [sf] of additional building space located on the existing campus located in Worcester, Massachusetts. This 1,880,000 sf expansion is comprised of 691,000 sf of emergency room and other associated hospital-related building area; and 1,189,000 sf of office, teaching, and other support-related building area. Approximately 7,431 new parking spaces are proposed as well to support this expansion in both structured and at-grade parking areas throughout the campus. The full build-out, as conceptualized, is presented in Figure 2.

Study Area

The study area for the project has been developed based on an understanding of the nature of the proposed development, its trip generation potential, and the likely travel routes that would be used by vehicles traveling to and departing from the campus. This study area is consistent with prior submissions to the City of Worcester made on behalf of UMMS/UMMHCS campus as part of a prior development[1]. It is possible that additional intersections may be required to be studied as part of a more comprehensive traffic assessment as it advances in to the city and state regulatory review process. For the purposes of this study, the following intersections and their approach roadways were studied as part of this traffic impact assessment:

Unsignalized Intersections

- Lake Avenue at North Road
- Lake Avenue North at northerly u-turn/Regatta Point parking lot
- Lake Avenue North at South Road
- Lake Avenue North at southerly u-turn/Shaw Building site drive

[1] UMass Medical School/UMass Memorial Health Care System Campus Modernization Program: *Environmental Notification Form*, VHB, Watertown, MA [July 2003]

Signalized Intersections

- Belmont Street [Route 9] at Shrewsbury Street
- Belmont Street at Plantation Street
- Plantation Street at South Road/Research Drive
- Plantation Street at North Road
- Belmont Street at Lake Avenue
- Boston Turnpike [Route 9] at Quinsigamond Avenue [Shrewsbury]

The study-area intersections are shown in Figure 3. An inventory of the existing physical conditions within the study area is presented in the following section of this document.

2

Existing Conditions

Evaluation of the transportation impacts associated with the proposed project requires a thorough understanding of the current transportation system in the project study area. Present transportation conditions observed in the study area include roadway geometry, traffic control devices, daily and peak hour traffic volumes, roadway operating characteristics, vehicle crashes, current available parking supply, transit opportunities, and pedestrian amenities. The following sections present a summary of this information.

Existing Roadway Network

The major travel routes and intersections within the study area are described below. Figure 3 shows the observed intersection lane geometry and traffic control within the study area.

Roadways

Belmont Street/Boston Turnpike [Route 9]

Route 9 [Belmont Street in the majority of the project area] is a median-divided arterial road under local jurisdiction. It runs in a general east/west direction, providing access to Shrewsbury to the east and Spencer to the west. Belmont Street intersects Shrewsbury Street, Plantation Street, Lake Avenue, and Quinsigamond Avenue through the project area. Lane widths on Belmont Street vary between 10 to 12 feet in the project area. Sidewalks are present along both sides of Belmont Street, although there are locations where the current sidewalk is in disrepair. Land uses are mostly commercial and retail with some hospital-related uses. The posted speed limit on the roadway varies between 30 and 35 miles per hour [mph] in the project area.

Plantation Street

Plantation Street is a local collector roadway through the project area. It is a median-divided roadway from Belmont Street to just north of North Road. Plantation Street is a two-lane roadway and runs in a general north/south direction, and provides access to I-290 and the UMMS/UMMHCS medical campus to the north and residential uses to the south. Much of this roadway was recently upgraded in the past ten years and is generally in good quality condition. Sidewalks are present along both sides of Plantation Street through the study area. The roadway intersects Belmont Street, North Road, and South Road in the project area. Lane widths on Plantation Street vary between 10 to 12 feet. Land uses on the street are hospital-related with residential uses north of North Road. The posted speed limit on the roadway ranges from 30 to 40 mph through the project area.

Lake Avenue North [north of Route 9]

Lake Avenue North is a local collector roadway through the project area. It is median-divided from Belmont Street to North Road and it runs in a general north/south direction, providing secondary access to the UMMS/UMMHCS campus, Regatta Point [a part of the Quinsigamond State Park], the National Guard Armory, a secondary access to the Massachusetts Highway Department District 3 Office, and multiple residential uses. Generally, Lake Avenue North is two lanes in each direction, narrowing to one lane in each direction just north of the study area. Sidewalks are present along the easterly side of Lake Avenue North, adjacent to the Regatta Point, and intermittently on the westerly side. Lane widths on Lake Avenue North vary between 14 to 28 feet in the project area. Wide lanes on Lake Avenue North operate as two lanes during peak period conditions. Two median breaks along Lake Avenue North allow left-turns and u-turns to occur along its length. The posted speed limit on Lake Avenue North ranges from 30 to 35 mph in the project area.

Left turns from westbound Belmont Street are not permitted at its intersection with Lake Avenue. Rather, motorists wishing to turn left must turn right and immediately u-turn on Lake Avenue North, and then proceed to travel through the intersection.

Quinsigamond Avenue

Quinsigamond Avenue is a local collector roadway through the project area, in Shrewsbury. It runs in a general north/south direction, providing access to I-290 to the north and Route 20 to the south. Generally, Quinsigamond Avenue is one lane in each direction. Sidewalks are present along each the easterly and westerly sides of Quinsigamond Avenue through the study area. Lane widths vary between 10 and 14 feet through the project area. Land uses near the project site are mostly retail and restaurant, with residential land uses farther north and south along Quinsigamond Avenue.

Intersections

Belmont Street [Route 9] at Shrewsbury Street

Belmont Street [Route 9] and Shrewsbury Street intersect to form a three-way, skewed signalized intersection. From the east, Belmont Street is designed to operate as two exclusive left-turn lanes and one through lane. However, this approach is signed for [and operates as] one exclusive left-turn lane, one shared though/left-turn lane, and one exclusive through lane. From the west, Belmont Street provides two through lanes. Eastbound right turns are prohibited at this intersection. Shrewsbury Street northeast-bound provides three exclusive right-turn lanes and one exclusive left-turn lane. All approach lane widths are between 10 and 12 feet wide. A crosswalk is present on the eastbound approach, with bituminous concrete sidewalks along the approaches of the intersection. However, there are no pedestrian signal indications at the intersection. Land uses near the intersection include a combination of commercial and retail land uses, as well as supporting hospital-related uses.

Belmont Street [Route 9] at Plantation Street

Plantation Street intersects Belmont Street from the north and the south to form a four-way signalized intersection. From the east, Belmont Street approaches the intersection on an uphill slope and provides an exclusive left-turn lane, two through lanes, and a channelized right-turn lane under YIELD control. From the west, Belmont Street approaches the intersection on a downhill slope and provides an exclusive left-turn lane, two through lanes, and a shared through/right-turn lane. From the south, Plantation Street approaches the intersection at a downhill slope and provides one through lane and one right-turn lane. Left turns are prohibited from occurring along this northbound approach. From the north, Plantation Street approaches the intersection on an uphill slope and provides separate exclusive left-, through, and right-turn lanes. The eastbound, westbound, and southbound approaches are all median-divided. Crosswalks are present across the northbound and southbound approaches. The traffic signal accommodates an exclusive pedestrian phase at the intersection. Bituminous sidewalks are present on all approaches. Land uses near the intersection include hotel, retail, office, and hospital parking.

Belmont Street [Route 9] at Lake Avenue

Lake Avenue intersects Belmont Street from the north and south to form a four-way signalized intersection. At the intersection, Lake Avenue provides an exclusive left, a through, and a shared through/right-turn lane in each the northbound and southbound directions. Belmont Street westbound provides three through lanes [two full through lanes and an short third lane] and a short, channelized right-turn lane. Belmont Street eastbound provides an exclusive left-turn lane, two through lanes, and an exclusive right-turn lane. All approach lane widths are between 10 and 12 feet wide. Crosswalks are present on all four approaches to the intersection, with sidewalks along all approaches to the intersection. The traffic signal accommodates an exclusive pedestrian phase at the intersection. Land uses near the intersection include hospital- and university-related uses, as well as retail and recreational uses.

It should be noted that westbound Belmont Street left turns are not permitted at this intersection. Motorists wishing to turn left must turn right and immediately u-turn on Lake Avenue North.

Boston Turnpike [Route 9] at Quinsigamond Avenue

Further east along Route 9 in Shrewsbury, Quinsigamond Avenue intersects Boston Turnpike from the north and south to form a four-way signalized intersection. At the intersection, Quinsigamond Avenue northbound provides two exclusive left turn lanes, one through lane, and one channelized right-turn lane. Southbound, the approach consists of an exclusive left-turn lane and a shared through-right-turn lane. Boston Turnpike eastbound provides an exclusive left-/u-turn lane, one through lane, and a shared through/right-turn lane. Westbound, the approach consists of an exclusive left-/u-turn lane, two through lanes, and a right-turn lane. All approach lane widths are between 10 and 14 feet wide. Crosswalks are present on all four approaches to the intersection, with sidewalks along all approaches to the intersection, except for the northerly side of the eastbound approach. Land uses near the intersection include restaurant and retail-related uses.

Lake Avenue North at North Road

North Road intersects Lake Avenue North from the west to form a three-way, 'T'-type, unsignalized intersection. The southbound approach of Lake Avenue North provides one 28-foot shared through/right-turn lane. The northbound approach of Lake Avenue North provides an exclusive through and a shared through/left-turn lane; each is 15 feet wide. North Road provides one left-turn lane under STOP control and one channelized right-turn lane under YIELD control. Both lanes are 18 feet wide at the intersection. Sidewalks are present along the easterly side of the intersection, adjacent to the Quinsigamond State Park. There are no crosswalks at this intersection. Land use near the intersection consists of residential uses to the northwest, hospital-related to the southwest, and recreational uses to the east.

Lake Avenue North at Northerly U-turn/Regatta Point parking lot

The Regatta Point parking lot site drive intersects Lake Avenue North from the east to form a three-way, 'T'-type unsignalized intersection. At the intersection, Lake Avenue North provides two through lanes and exclusive left-turn lanes in each the northbound and southbound directions. The northbound and southbound left-turn bays also accommodate respective u-turns. The approach lane widths vary from 9 to 10 feet for the left-turn lanes and 12 to 18 feet for the through lanes. The Regatta Point driveway provides one 18-foot full-access approach. Sidewalks are present only along the easterly side of the intersection, adjacent to the Regatta Point. A 10-foot crosswalk is present across the northerly approach at the intersection. A staircase, 20 feet north of the crosswalk on the westerly side of the intersection, provides direct access between the hospital and the Regatta Point public parking lot. Land use near the intersection consists of recreational uses to the east and hospital-related uses to the west.

Lake Avenue North at South Road

South Road intersects Lake Avenue North from the west to form a 'right-in/right out' three-way unsignalized intersection. On the southbound approach, Lake Avenue North provides one shared through/right-turn lane and one exclusive through lane. Northbound, Lake Avenue North provides two exclusive through lanes. Access to South Road is not available from the northbound approach. Lane widths on the Lake Avenue North approaches range from 14 to 18 feet. South Road provides one 22-foot wide channelized right-turn lane under STOP control. Sidewalks are present along the easterly side of the intersection, adjacent to the Regatta Point, and on the westerly side just south of the intersection. Land uses near this intersection include a MassHighway district office to the southwest, the medical campus to the northwest and recreational uses to the east.

Lake Avenue North at Southerly U-turn/Shaw Building site drive

The Shaw Building site drive intersects Lake Avenue North from the west to form a three-way 'T'-type unsignalized intersection. On the southbound approach, Lake Avenue North provides one shared through/right-turn lane and one exclusive through lane. Northbound, Lake Avenue North provides one exclusive through lane and one shared through/left-turn lane. Both the northbound and the southbound approaches accommodate u-turns. Lane widths on the Lake Avenue North approaches range from 14 to 16 feet. The Shaw Building site drive provides one single-lane, full-access approach. Sidewalks are present along both sides of Lake Avenue North. The intersection provides no crosswalks. Land uses near this intersection include hospital-related uses to the southwest, an armory to the northwest, and recreational uses to the east.

Plantation Street at South Road/Research Drive

South Road and Research Drive intersect Plantation Street from the east and west, respectively, to form a four-way signalized intersection. South Road and Research Road approach the intersection on an uphill and downhill slope, respectively. Each approach provides two shared through/turn lanes. Plantation Street provides exclusive left-turn lanes, as well as shared through/right-turn lanes on each the northbound and southbound approaches. All four approaches are median-separated. Crosswalks and sidewalks are present on all approaches. However, there are no pedestrian signal indications at the intersection. Land uses near the intersection include office, university, and hospital and daycare parking.

Plantation Street at North Road

North Road intersects Plantation Street from the east to form a three-way 'T'-type signalized intersection. North Road approaches the intersection on an uphill slope and provides one general-purpose lane. Plantation Street provides one through lane and one shared through/turn lane onto North Road in each direction. Plantation Street is median-divided on both approaches. Crosswalks are present on the westbound and northbound approaches, with sidewalks along both sides of Plantation Street and the southerly side of South Road. The traffic signal accommodates an exclusive pedestrian phase at the intersection. Land uses near the intersection include research buildings, university, and hospital uses.

Traffic Volumes

To determine the baseline traffic conditions along the study area roadways, 48-hour automatic traffic recorder [ATR] counts were conducted on the three main study area roadways in May 2003. The results of these ATR counts are summarized in Table 1.

Table 1
Existing Traffic Volume Summary

Location	ADT [a]	Morning Peak Hour			Evening Peak Hour		
		Volume	K Factor [b]	Dir. Dist. [c]	Volume	K Factor	Dir Dist
Belmont Street [Route 9], west of Plantation Street	39,600	2,590	6.5%	51% WB	3,030	7.7%	54% WB
Plantation Street, north of Belmont Street [Route 9]	22,700	2,150	9.5%	53% NB	1,910	8.4%	66% SB
Lake Avenue North, north of Belmont Street [Route 9]	16,300	1,140	7.0%	76% NB	1,240	7.6%	60% SB

source: based on automatic traffic recorder counts conducted in May 2003
a Average Daily Traffic volume, expressed in vehicles per day
b represents the percent of daily traffic which occurs during the peak hour
c directional distribution of peak hour traffic
note: peak hours do not necessarily coincide with the peak hours of turning movement counts

As Table 1 illustrates, the ATR volumes indicate that on a typical weekday, approximately 39,600 vehicles per day [vpd] travel on Belmont Street. Typical commuter morning and evening peak hours represent approximately 6 to 8 percent of the daily traffic on this roadway. During the typical weekday morning and evening peak hours, approximately 51 and 54 percent of the traffic, respectively, flows westbound.

The ATR volumes also indicate that on a typical weekday, approximately 22,700 vpd travel on Plantation Street. Typical commuter morning and evening peak hours represent approximately 8 to 10 percent of the daily traffic on this roadway. During the typical weekday morning peak hour, approximately 53 percent of the traffic flows northbound, while during the typical evening peak hour, approximately 66 percent of the traffic flows southbound.

Finally, the traffic volumes indicate that indicate that on a typical weekday, approximately 16,300 vpd travel on Lake Avenue North. Typical commuter morning and evening peak hours represent approximately 7 to 8 percent of the daily traffic on this roadway. During the typical weekday morning peak hour, approximately 76 percent of the traffic flows northbound, while during the typical evening peak hour, approximately 60 percent of the traffic flows southbound.

Concurrent with the ATR counts, manual turning movement counts [TMCs] were conducted at the ten study-area intersections during a typical weekday morning from 7:00 AM to 9:00 AM and typical weekday evening from 4:00 PM to 6:00 PM in May and June 2003. Supplemental traffic counts were also conducted in January 2005 to confirm that no significant changes to traffic patterns have occurred between the original 2003 observations and the time when this traffic document was prepared. Comparison of traffic count data with historic seasonal data available from MassHighway indicated that May and June traffic counts are approximately 8 to 11 percent *higher* than the annual average month conditions, while January traffic counts are typically six percent *lower* than the average annual month conditions. However, the supplemental traffic count conducted in January 2005 included overlapping intersections from the May/June 2003 traffic counts. A comparison of the coincident peak period traffic volumes indicated that the January 2005 and May/June 2003 traffic volumes are comparable. The Existing weekday morning and evening peak hour traffic volumes are shown in Figures 4 and 5, respectively.

Vehicle Crash Summary

To identify potential vehicle crash trends in the project study area, the most current vehicle crash data for the study area intersections was obtained from MassHighway for the years 1999 through 2002. A summary of the MassHighway vehicle crash history is presented in Table 2.

The 2001 MassHighway average crash rates for signalized and unsignalized intersections for District 3 [the MassHighway district designation for Worcester] are 0.83 and 0.80, respectively. As shown in Table 2, three study area intersections exceed the MassHighway District 3 average crash rate values.

Table 2
Vehicular Crash Summary [1999 - 2002]

	Lake Avenue North at				South Road at	Route 9 at				Plantation Street at	
	North Rd.	N. U-turn/Regatta Pt.	South Rd.	S. U-turn/Shaw Building	Second Rd./South Lot	Shrewsbury St.	Plantation St.	Lake Ave.	Quinsigamond Ave.	South Rd.	North Rd.
Signalized	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Year											
1999	1	0	1	0	0	14	22	31	16	0	1
2000	1	0	0	0	0	17	38	24	14	1	4
2001	0	0	0	0	0	16	35	12	16	0	3
2002	1	0	0	0	0	17	23	16	7	2	1
Total	3	0	1	0	0	64	118	83	53	3	9
Collision Type											
Angle	0	0	0	0	0	30	43	34	11	3	4
Head-on	0	0	0	0	0	3	3	2	0	0	1
Rear-end	2	0	1	0	0	14	46	32	30	0	2
Unknown	1	0	0	0	0	17	26	15	12	0	2
Total	3	0	1	0	0	64	118	83	53	3	9
Severity											
Fatality	0	0	0	0	0	0	0	0	0	0	0
Hit and Run	0	0	0	0	0	4	1	3	0	0	0
Injury Crash	2	0	0	0	0	11	33	24	14	1	4
Property Only	1	0	1	0	0	39	78	55	38	1	5
Unknown	0	0	0	0	0	10	6	1	1	1	0
Total	3	0	1	0	0	64	118	83	53	3	9
Time of day											
7:00 AM to 9:00 AM	0	0	0	0	0	5	18	8	5	0	3
4:00 PM to 6:00 PM	0	0	0	0	0	7	13	8	5	0	2
Other	3	0	1	0	0	52	87	67	43	2	4
Total	3	0	1	0	0	64	118	83	53	3	9
Day of Week											
Monday-Friday	1	0	1	0	0	47	90	68	41	2	8
Saturday-Sunday	2	0	0	0	0	17	28	15	12	1	1
Total	3	0	1	0	0	64	118	83	53	3	9
Pavement Conditions											
Snow	0	0	0	0	0	1	6	0	1	1	0
Dry	3	0	0	0	0	45	72	63	38	2	7
Wet	0	0	1	0	0	16	34	18	13	0	2
Icy	0	0	0	0	0	2	4	0	0	0	0
Unknown	0	0	0	0	0	0	2	2	1	0	0
Total	3	0	1	0	0	64	118	83	53	3	9
MassHighway Crash Rate	0.10	0.00	0.03	0.00	0.00	1.35	1.26	0.83	0.66	0.07	0.24
Exceeds MassHighway Crash rate?	no	no	no	no	no	yes	yes	yes	no	no	no

source MassHighway crash data
note. MassHighway crash rates for District 3 are 0.83 for signalized intersections and 0.80 for unsignalized intersections

As the data in Table 2 indicates, the intersections with the most vehicle crashes are all along Belmont Street, the most heavily traveled roadway in the study area. Angle and rear-end crashes were the most frequent type of crashes. Many of these were likely due to excessive speed on the approaches, large intersection volumes, and inadequate traffic signal clearances. The majority of these crashes occurred during non-commuter peak hours during the typical workweek. The majority of these crashes also occurred on dry pavement. There were no reported fatalities at any of the study area intersections during the four-year period.

Modifications aimed at improving traffic operations – and therefore the *safety* – at each of the intersections that exceed the MassHighway Crash Rate are discussed later in this document.

Available Parking Supply

Based on field observations and inventories and information provided by UMMS/UMMHCS personnel, the hospital and university has a current parking supply of approximately 5,190 spaces among three types of parking areas:

- 4,417 on-site parking spaces in surface lots and garages;
- 92 on-site parking spaces as designated 'on-street' parking; and
- 681 off-site parking spaces in reserved parking lots.

A description and summary of each is provided below.

On-Site Parking [lots and garage]

Eleven designated parking lots are provided for hospital- and university-related motorists. Two garages are provided to the west and south of the hospital and university. Each parking lot and garage is reserved for specific users, including employees, patients, and visitors. The 11 lots and 12 garage levels comprise 4,417 parking spaces, approximately 85 percent of the total available parking supply.

On-Site Parking [on-street]

On-street parking is permitted along four internal roadways. This on-street parking includes a combination of metered parking, handicapped parking, and permit parking spaces for hospital staff. Of these designated roadways, North Road offers the most on-street parking spaces [59], connecting Lake Avenue North and Plantation Street. These four internal roadways comprise 92 parking spaces, approximately 2 percent of the total available parking supply. The majority of these spaces are traditionally utilized by emergency room patients and staff as overflow parking from the designated ER parking area.

Off-Site Parking

Finally, five off-site parking lots are available to hospital- and university-related motorists. Three of these lots are owned by UMMS/UMMHCS, and two are leased.

The Shaw lot, owned and maintained by UMMS/UMMHCS, is located on the northwesterly corner of Lake Avenue North and Belmont Street. The parking lots serving One Biotech and Two Biotech, in the Biotech complex west of Plantation Street, are also owned and maintained by UMMS/UMMHCS. The parking lot serving Four Biotech is leased through UMMS/UMMHCS, as well as 48 spaces adjacent to the Three Biotech building.

The five total off-site parking lots comprise 681 parking spaces, approximately 13 percent of the total available parking. Table 3 and Figure 6 summarize and illustrate the available parking at the campus.

Table 3
Existing Parking Supply Summary

Code	Parking Area	Existing Supply
On-Site Parking Lots and Garages		
1	Basic	126
2	Benedict	33
3	Clinical	92
4	Daycare	15
5	East	229
6	Emergency	11
7	Handicapped	19
8	Middle	210
9	Pine Tree	469
10	Power Plant	43
11	South Parking Garage	1,600
12	West	101
13a-13f	West Parking Garage	1,469
On-site Parking [on-street]		
14	North Road	59
16	First Road	7
17	Second Road	18
18	Third Road	8
Off-Site Parking		
20	One Biotech	205
21	Two Biotech	183
22	Four Biotech	101
23	Three Biotech	48
OC1	Shaw Lot	144
	Total	***5,190***

source: based on UMMS/UMMHCS-supplied information and VHB field inventory [June 1, 2003]

Current Parking Ratios

No projections of future staffing or patient activity are available, so for the purposes of estimating current parking demand, planning ratios of parking spaces per 1,000 sf of gross square foot of building space are used. As described later in this document, the gross square footage of the current UMMS/UMMHCS campus is 2,063,711 sf. Table 3 above indicates that there are a total of 5,190 available parking spaces. This equates to a 2.51 parking spaces per 1,000 square feet of gross building space. Should the full build-out of the Master Plan be realized, UMMS/UMMHCS should maintain, at a minimum, this parking ratio.

Transit Opportunities

Public transit options are available to the staff, patients, and visitors to the UMMS/UMMHCS campus. The following is a brief summary of those services serving the area.

Bus Service

The Worcester Regional Transit Authority [WRTA] runs bus service near the site via two routes: the Route 15 – Shrewsbury and Route 24E – Belmont Street/ Lake Avenue Line, as summarized in Table 4. Route 15 begins service at Main Street and Main Circle. The route runs southwest on Maple Street, west on Belmont Street, south on Shrewsbury Street, through Washington Square, and ends in downtown Worcester at Foster Street and Waldo Street. The bus makes scheduled stops at Fairlawn Plaza and the project site. Weekday service runs from 6:10 AM to 7:00 PM with one hour headways. On Saturday, service runs from 9:15 AM to 6:15 PM with one or two hour headways. There is no Sunday service for this line. Route 15 also has an alternate start location at South Quinsigamond Avenue at Lake Street. This route travels north on South Quinsigamond Avenue, then continues west on Belmont Street, with the aforementioned principal course to end at Foster Street and Waldo Street. The alternate route's only scheduled stop is at the project site. There are two weekday start times from the alternate location – 10:35 AM and 1:35 PM. On Saturday and Sunday, there is no service from this location. From Foster Street and Waldo Street, buses continue west as Route 21 – Highland/Assumption College.

The 24E Line begins at City Hall on Main Street in downtown Worcester. The route runs east on Belmont Street, takes a service road north near Worcester State Hospital, and continues east to service the site on South Street. The route then heads north to end on Lake Avenue at George Booth Apartments. Scheduled stops for this route include Medical Center of Central Massachusetts and the project site. Weekday service runs from 5:50AM to 8:40PM, with approximate 30 minute headways. On Saturday, service runs from 6:15 AM to 8:15 PM with one hour headways. Sunday service runs from 10:30 AM to 7:30 PM with one or two hour headways. From City Hall, buses continue west as Route 24W - Washington Heights/Logan Field.

Commuter Rail

The Massachusetts Bay Transportation Authority [MBTA] runs commuter rail service to downtown Worcester from points east via the Framingham/Worcester line. The service begins at South Station in Boston and ends in Worcester with multiple stops along the route. Weekday service begins at 6:50 AM and ends at 10:05 PM with intermittent headways. Saturday and Sunday service begin at 7:50 AM and ends at 11:00 PM, also with intermittent headways. From the station, commuters may access either the 24E bus or the 15 bus for continued service to the project site. Table 4 also provides a summary of the commuter rail schedule.

Table 4
Existing Transit Service Summary

Mode	Weekday Start Time	Weekday End Time	Weekday Headways
Bus Route 15 [Shrewsbury]	6:10 AM	7:00 PM	60 minutes
Bus Route 24 E [Belmont St/Lake Ave]	5:50 AM	8:40 PM	30 minutes
Commuter Rail - Framingham/ Worcester Line	6:50 AM	10:05 PM	*intermittent*

sources: http://www.therta.com/schedules.htm
http://www.mbta.com/traveling_t/schedules_commuter_linedetail.asp?line=framingham

Pedestrian Amenities

VHB inventoried the presence of sidewalks and passable pedestrian walkways through the study area. In general, the study area has a moderate amount of sidewalks with a fair amount of connectivity, as well as crosswalks at the major intersections. A summary of the passable pedestrian walkways [sidewalks, paths, and crosswalks] is presented in Figure 7.

Existing Area Transportation Infrastructure Deficiencies

Throughout the study area, several intersections are currently operating at sub-optimal levels. This is due to the intersections already processing a large amount of vehicular volume; sub-standard intersection geometry and/or traffic control; or a combination of both. VHB has identified these locations, and they are presented graphically in Figure 8.

As expected, three of the four study area intersections along Route 9 are operating near, at, or even over theoretical capacity during the weekday morning and evening peak periods. In addition, the 'front door' of the hospital – the main entrance along Plantation Street – also exhibits significant congestion during the weekday morning and evening peak periods.

With the addition of either background traffic growth or site-generated traffic as part of the UMMS/UMMHCS Mater Plan projects, the additional trips to the area's roadway system would be expected to further degrade the operations at other study area intersections.

Discussions of the future traffic growth in the area and recommended transportation infrastructure improvements are presented later in this document.

3 Future Conditions

To determine the impacts of the site-generated traffic volumes on the surrounding roadway network, future traffic conditions were analyzed for the year 2013. The year 2013 was selected as the horizon year for the purposes of quantifying and assessing future transportation impacts generated by the entire project. Independent of the proposed project, volumes on the roadway network under the future No-Build conditions were assumed to include existing traffic and new traffic resulting from background traffic growth. Anticipated site-generated traffic volumes were added to the future No-Build traffic volume networks to reflect the future Build conditions within the project study area.

No-Build Traffic Volumes

No-Build traffic volumes include all existing traffic and any new traffic due to background traffic growth by 2013. Consideration of these factors resulted in the creation of the future No-Build condition traffic volumes.

Annual Background Traffic Growth

A review of historic data published by MassHighway for roadways near the project site indicated that daily traffic volumes in the area have increased by approximately two percent per year over the past few years. Previously, Worcester's City traffic engineer agreed that a two percent per year annual background traffic growth would be appropriate for the study area. Therefore, a two percent per year background growth rate was used for the future No-Build analysis.

The two percent per year general background growth was then added to the Existing conditions traffic volumes to develop the future No-Build weekday morning and evening peak hour traffic volume networks. These networks are shown in Figures 9 and 10.

Planned Area Roadway Improvements

In assessing future traffic conditions, proposed roadway improvements within the study area were considered. According to readily-available information, no roadway improvement projects that could affect capacity in the Worcester portion of the study area are planned.

However, the Boston Turnpike/Quinsigamond Avenue intersection [in Shrewsbury] has been included in a recent design submission for improvements as part of a MassHighway signal and roadway improvement project. These improvements were recently put out to bid and will likely go to construction sometime in mid- to late 2005 or early 2006. These improvements will include a replacement of the traffic signal equipment and coordination with other signalized locations along Route 9 in Shrewsbury, as well as geometric improvements aimed at improving the traffic flow into and out of the various commercial properties near this signal.

Site-Generated Traffic

To evaluate the impact of the proposed development of the 1,880,000 sf expansion of the UMMS/UMMHCS campus on the study area intersections, the number of new vehicular trips arriving and departing from the development site needs to be estimated. ITE's *Trip Generation*[2], an industry-standard method, was used to estimate both the existing and anticipated site-generated trips by using estimates based on the various components of the development. The ITE estimates for the existing trip generation were compared to the actual, observed existing traffic generation at the site. If these estimates generally agree, this ensures that ITE is a reasonable and accurate method to project the future site's trip generation potential.

The trip generation estimation for the development's expansion plans was conducted in three phases:

- First, identify the components of development to be constructed on the site and the ultimate uses [hospital space, office/administrative space, and/or academic space].
- Second, estimate the amount of traffic to be generated by the entire development expansion.
- Third, estimate the amount of traffic to be generated by each individual component.

[2] ITE: *Trip Generation, Sixth Edition*, Institute of Transportation Engineers, Washington, DC [1997]

Development Phases

The components of the four identified phases of the Master Plan are summarized below in Table 5. For the purposes of the transportation assessment, the campus was divided in to four quadrants [A, B, C, and D]. Each of these quadrants will likely have unique transportation trends, such as arrival and departure patterns, parking demand, and linkage to the existing main campus. This phased approach is not intended to outline a suggested development pattern, but rather to simply *identify* and *recognize* that a motorist attempting to arrive at, for example, the northwestern corner of the site will likely follow a different commuting pattern than someone arriving at the southeastern corner of the development.

Table 5
Development Phases

Phase	Location	Office Space [sf]	Hospital Space [sf]	Total Space [sf]	New Parking Spaces
A	emergency room division	0	445,000	445,000	2,651
B	northwest quadrant	477,000	0	477,000	2,240 [a]
C	southwest quadrant	344,000	0	344,000	1,410
D	southeast quadrant	368,000	246,000	614,000	1,130
Total	--	1,189,000	691,000	1,880,000	7,431

source: T/KA proposed Master Plan site plan, dated March 1, 2005
a 269 parking spaces would also be removed from the existing parking garage

As Table 5 indicates, the total expansion of the UMMS/UMMHCS facility would result in 1,880,000 sf of additional hospital and hospital-related space. An additional 7,431 parking spaces would be constructed to support the full build-out of the Master Plan.

Traffic Projections

To estimate the trip-generating characteristics for the proposed development plan, traffic projections were derived from trip generation rates published by the Institute of Transportation Engineers [ITE] *Trip Generation*, as previously described. Because the ITE information is based on national averages and not necessarily specific to the actual UMMS/UMMHCS development in Worcester, VHB examined actual traffic counts that were conducted in July 2003 for the Expanded ENF prepared for the Campus Modernization Program. A summary of this comparison is presented below in Table 6.

Table 6
Existing Trip Generation Summary

Via...	Actual Observed Traffic at the Campus	ITE: Hospital	ITE: General Office	Total Existing Campus [b]
Size [sf]	2,063,711	783,623	1,280,088	2,063,711
Method	observed [a]	ITE 7th ed. [regression]	ITE 7th ed. [regression]	ITE 7th ed. [regression]
Weekday AM [d]				
Enter	1,475	575	1,270	1,845
Exit	415	285	175	460
Total	1,890	860	1,445	2,305
Weekday PM [d]				
Enter	475	260	255	515
Exit	1,345	530	1,255	1,785
Total	1,820	790	1,510	2,300

a as shown in VHB's July 2003 ENF
b applies ITE LUC 610 [hospital] for UMass teaching hospital and the Benedict Building [783.62 ksf]; applies ITE 710 [office space] to the UMass medical school and the LRB [1,280.09 ksf]
c traffic volumes expressed in trips per day
d traffic volumes expressed in trips per hour

As Table 6 indicates, the peak period traffic counts at the site indicated that the existing site generates approximately 1,890 and 1,820 weekday morning and weekday evening peak period trips, respectively. The ITE estimates for hospital and office, the two *closest* land uses represented in the ITE database, indicate that the existing site should generate approximately 2,300 trips during each the weekday morning and weekday evening peak period. This results in the ITE data over-estimating the actual trip generation at the existing site by approximately 20 to 25 percent. One reason for this is that the observed traffic counts do not take into account the off-site parking that is occurring at the campus and may or may not be influenced by the amount of public transit serving the site.

Regardless, the results of the evaluation indicate that the ITE trip generation calculations result in more peak period traffic volume than the actual, observed traffic volumes. Therefore, to prevent a conservative 'worst-case' evaluation, the ITE trip generation projections were used to forecast the future anticipated trip generation impact associated with the 1,880,000 sf development plan.

The vehicular trip increase that is anticipated due to the full build-out of the UMMS/UMMHCS Master Plan is summarized below in Table 7.

Table 7
Net Trip Generation Impact of Master Plan Expansion

Period/Condition	Existing [a]	Proposed [b]	Net Increase [c]
Weekday Daily [d]			
Enter	9,780	16,670	6,890
Exit	9,780	16,670	6,890
Total	19,560	33,340	13,780
Weekday AM [e]			
Enter	1,845	2,980	1,135
Exit	460	825	365
Total	2,305	3,805	1,500
Weekday PM [e]			
Enter	515	885	370
Exit	1,785	2,915	1,130
Total	2,300	3,800	1,500

a as shown in VHB's July 2003 ENF and in Table 6 of this document
b assumes building program as described in Table 5
c 'Proposed' minus 'Existing'
d traffic volumes expressed in trips per day
e traffic volumes expressed in trips per hour

As shown in Table 7, the UMMS/UMMHCS development plan, when completed in its entirety and occupied, could generate approximately 13,780 new daily trips during a weekday over what is currently being generated at the campus today. This would include approximately 1,500 new trips during each the weekday morning and weekday evening peak hours.

While it is likely that the development would be constructed in a phased approach [as noted previously], not all of these new vehicle trips would be expected at the same time. While the construction phasing program currently is not known, the trip generation projections for this site were estimated based on the development of the four quadrants of the site. The trip generation projections of each quadrant of the development Master Plan are summarized below in Table 8. The detailed trip generation evaluation worksheets and building size assumptions are included in the appendix.

Table 8
Anticipated Development Phase Trip Generation

Phase [a] Period/Phase Location	A emergency room division	B northwest quadrant	C southwest quadrant	D southeast quadrant	Total [b]
Weekday Daily [c]					
Enter	3,187	7,64	554	2,385	6,890
Exit	3,187	7,64	554	2,385	6,890
Total	6,374	1,528	1,108	4,770	13,780
Weekday AM [d]					
Enter	387	212	154	382	1,135
Exit	189	28	20	128	365
Total	576	240	174	510	1,500
Weekday PM [d]					
Enter	151	54	39	126	370
Exit	304	262	190	374	1,130
Total	454	316	229	500	1,500

a as described in Table 5
b as shown in Table 7
c traffic volumes expressed in trips per day
d traffic volumes expressed in trips per hour

As shown, the development of the emergency room division area and the southeastern quadrant of the campus will result in the major traffic generation at the site. The northwest quadrant is mostly developed already with the only major modifications being to the parking structures that would need to be improved to support the development of the site.

Trip Distribution

The directional distribution of the additional project-generated traffic approaching and departing the site is expected to be similar to the travel patterns of current site traffic. Traditional trip patterns made to and from the hospital during the peak hours are expected to be predominantly entering in the morning peak hour and exiting in the evening peak hour. The preliminary trip distribution patterns for the UMMS/UMMHCS Master Plan were based on the observed trip distribution patterns. These patterns were developed from the existing travel patterns through the study area at each of the four campus entrance/exit points [North Road and South Road at Plantation Street and Lake Avenue North]. Then, the trip distribution patterns for the Master Plan were conservatively adjusted to reflect the likely arrival and departure patterns of visitors and staff. Consideration of available parking supply was also considered in this assessment. The trip distribution patterns are presented below in Table 9 and Figure 11.

Table 9
Vehicle Trip Distribution Summary

Route	Direction [from/to]	Percent of Total
Plantation Street	north	24
Lake Avenue North	north	9
Route 9 [east of Quinsigamond Avenue]	east	18
Quinsigamond Avenue, south of Route 9	south	5
Quinsigamond Avenue, north of Route 9	north	2
Lake Avenue South	south	16
Plantation Street	south	9
Shrewsbury Street	west	7
Route 9 [west of Shrewsbury Street]	west	8
Research Drive [west of Plantation Street]	west	2
Total	–	*100%*

Table 9 indicates that approximately one third of the campus-related traffic arrives from and departs to each the north and the south. The remaining third arrives from and departs to the site from the east and west combined.

The full-build site-generated traffic for the weekday morning and weekday evening peak periods was estimated based on Tables 7, 8, and 9 and is shown graphically in Figures 12 and 13, respectively. These volumes were then added to the No-Build peak hour traffic volumes to develop the future Build weekday morning and evening peak hour traffic volumes, shown in Figures 14 and 15, respectively.

Future Parking Supply

As part of the Campus Modernization Program, a 1,600-space parking garage was proposed on the location of the South lot. The parking garage was proposed to eliminate some of the need for leased satellite parking lots [such as Regatta Point and Worcester State Hospital]; on-street parking [such as South Road]; and to accommodate future parking demand associated with the Campus Modernization Program.

To support the overall UMMS/UMMHCS Mater Plan, a total of 7,431 new parking spaces in seven garages are proposed. Approximately 1,227 parking spaces would need to be removed, most in surface lots, to allow the construction of the proposed garages. Table 10 and Figure 16 summarize and illustrate the proposed future parking supply.

Table 10
Future Parking Supply Summary

Code	Parking Area	Existing Supply	Proposed Change	Net Supply
On-Site Parking Lots and Garages				
1	Basic	126		126
2	Benedict	33		33
3	Clinical	92		92
4	*Daycare*[a]	*15*	*-15*	*0*
5	*East*[b]	*229*	*-229*	*0*
6	Emergency	11		11
7	Handicapped	19		19
8	Middle	210		210
9	*Pine Tree*[c]	*469*	*-469*	*0*
9a	*Southwest Parking Garage*[d]	*0*	*1,410*	*1,410*
10	Power Plant	43		43
10a	*Northeast Garage*[e]	--	*2,651*	*2,651*
11	South Parking Garage	1,600		1,600
12	*West*[f]	*101*	*-101*	*0*
12a	*Northwest Parking Garages*[g]	*0*	*2,240*	*2,240*
13a-13f	*West Parking Garage*	*1,469*	*-269*	*1,200*
14	*Southeast Parking Garage*[h]	*0*	*1,130*	*1,130*
On-site Parking [on-street]				
14	North Road	59		59
16	First Road	7		7
17	Second Road	18		18
18	Third Road	8		8
Off-Site Parking				
20	One Biotech	205		205
21	Two Biotech	183		183
22	Four Biotech	101		101
23	Three Biotech	48		48
OC1	*Shaw Lot*[i]	*144*	*-144*	*0*
	Total	***5,190***	***6,204***	***11,394***

source: based on VHB field inventory [June 1, 2003], UMMS/UMMHCS-supplied information, and T/KA site plan
italicized values are changes from current parking supply

a would be removed for northwest parking garages
b would be removed for northeast parking garage
c would be removed for southwest parking garage
d would support community medical proposed in southwest quadrant
e would support expanded ERD, support buildings, etc. programmed for northeast quadrant
f would be removed for northwest parking garages
g three garages: 795 spaces; 1,145 spaces; and 300 spaces
h two garages: 343 spaces; 787 spaces
i would be removed for southwest parking garages

■

Future Parking Ratios

As previously described, the Master Plan consists of expanding the UMMS/UMMHCS campus by approximately 1,880,000 sf. This would result in an overall campus size of 3,943,711 sf. As part of this Master Plan, a total of 11,394 parking spaces would be available. Similar to the current parking ratios, future parking demand planning ratios are described in terms of parking spaces per 1,000 sf of gross square foot of building space. Under the proposed full-build of the campus and construction of parking spaces, the future UMMS/UMMHCS campus would have a parking ratio of 2.89 parking spaces per 1,000 square feet of gross building area.

4

Traffic Operations Analysis

Measuring existing traffic volumes and projecting future traffic volumes quantifies traffic within the study area. To assess quality of flow, roadway capacity analyses were conducted with respect to existing conditions and projected No-Build, and Build traffic volume conditions. Capacity analyses provide an indication of the adequacy of the roadway facilities to serve the anticipated traffic demands.

Level-of-Service Criteria

The evaluation criteria used to analyze area intersections and roadways in this traffic study are based on the 2000 *Highway Capacity Manual* [HCM][3].

Level of service [LOS] is the term used to denote the different operating conditions that occur on a given roadway segment under various traffic volume loads. It is a qualitative measure that considers a number of factors including roadway geometry, speed, travel delay, freedom to maneuver, and safety. Level of service provides an index to the operational qualities of a roadway segment or an intersection. Level-of-service designations range from A to F, with LOS A representing the best operating conditions and LOS F representing the worst operating conditions.

The level-of-service designation is reported differently for signalized and unsignalized intersections. For signalized intersections, the analysis considers the operation of all traffic entering the intersection and the LOS designation is for overall conditions at the intersection. For unsignalized intersections, however, the analysis assumes that traffic on the mainline is not affected by traffic on the side streets. Thus, the LOS designation is for the critical movement exiting the side street, which is generally the left-turn out of the side street.

[3] 2000 Highway Capacity Manual, Transportation Research Board – National Research Council, Washington, D.C. (2000)

In addition to LOS, two other measures of effectiveness [MOEs] are typically used to quantify the traffic operations at intersections; volume-to-capacity ratio [v/c] and delay [expressed in seconds per vehicle]. For example, an existing v/c ratio of 0.9 for an intersection indicates that the intersection is operating at 90 percent of its available capacity. A delay of 15 seconds for a particular vehicular movement or approach indicates that vehicles on the movement or approach will experience an average additional travel time of 15 seconds. It should be noted that v/c and delay could have a range of values for a given LOS letter designation. Comparison of intersection capacity results therefore requires that, in addition to the LOS, the other MOEs should also be considered.

It should be noted that the analytical methodologies typically used for the analysis of unsignalized intersections use conservative analysis parameters, such as long critical gaps. Actual field observations indicate that drivers on minor streets generally accept shorter gaps in traffic than those used in the analysis procedures and therefore experience less delay than reported by the analysis software. The analysis methodologies also do not fully take into account the beneficial grouping effects caused by nearby signalized intersections. The net effect of these analysis procedures is the over-estimation of calculated delays at unsignalized intersections in the study area. Cautious judgment should therefore be exercised when interpreting the capacity analysis results at unsignalized intersections.

Level-of-Service Analysis

Levels of service analyses were conducted for the Existing, No-Build, and Build conditions for the signalized and unsignalized study-area intersections.

Signalized Intersection Capacity Analysis

Signalized capacity analyses were conducted for the six signalized intersections in the study area under the three conditions studied. Table 11 presents a summary of these analyses. The capacity analyses worksheets are included as an appendix to this document.

Table 11
Signalized Intersection Capacity Analysis Summary

Location	Period	Existing v/c [a]	Existing Delay [b]	Existing LOS [c]	No-Build v/c	No-Build Delay	No-Build LOS	Build v/c	Build Delay	Build LOS
Belmont Street [Route 9] at	weekday morning	0.52	15	B	0.65	20	C	0.70	21	C
Shrewsbury Street	weekday evening	0.62	15	B	0.80	15	B	0.84	15	B
Belmont Street at	weekday morning	0.93	59	E	1.14	97	F	1.30	129	F
Plantation Street	weekday evening	0.94	63	E	1.16	100	F	1.27	126	F
Plantation Street at	weekday morning	0.58	15	B	0.63	16	B	0.92	70	E
South Road	weekday evening	0.76	19	B	0.84	22	C	1.19	82	F
Plantation Street at	weekday morning	0.53	6	A	0.60	7	A	1.04	35	C
North Road	weekday evening	0.47	6	A	0.56	7	A	0.93	20	B
Belmont Street at	weekday morning	0.83	44	D	1.03	53	D	1.15	89	F
Lake Avenue	weekday evening	0.87	59	E	1.06	75	E	1.30	137	F
Boston Turnpike at	weekday morning	0.76	22	C	0.98	49	D	1.06	84	F
Quinsigamond Avenue	weekday evening	1.23	87	F	1.52	156	F	1.65	*	F

a volume-to-capacity ratio
b average delay in seconds per vehicle
c level of service
* v/c ratio exceeds 1.2 and/or delay exceeds 180 seconds

Field investigations and the analyses summarized above indicate that *existing* traffic operational deficiencies are present at the Belmont Street/Plantation Street, Belmont Street/Lake Avenue, and Boston Turnpike/Quinsigamond Avenue intersections. These intersections operate at LOS E or worse in either one or both of the peak periods under the Existing conditions. Increases in delay are attributable to the additional background traffic in the future No-Build conditions. As expected, site-generated traffic from the proposed project is anticipated to add significant overall intersection delays at most study area intersection locations.

The peak hour intersection operations at the Belmont Street/Shrewsbury Street and Plantation Street/North Road intersections are projected to worsen, but remain operating at LOS C or better. The delay increases at the Plantation Street/ South Road intersection are attributable to the fact that it is widely known as the main entrance to the campus. At least 26 percent of the site-generated traffic is anticipated to arrive at the site overall through this intersection.

■

Unsignalized Intersection Capacity Analysis

Intersection capacity analyses were also conducted at the four unsignalized study-area intersections for the weekday morning and weekday evening peak hours under Existing and future No-Build and Build conditions. The analysis results for unsignalized intersections reflect the operation of the critical turning movements on the minor street, typically the left turn. The analysis assumes that mainline traffic is unaffected by side street traffic. Table 12 summarizes the capacity analysis results for the unsignalized study-area intersections.

Table 12
Unsignalized Intersection Capacity Analysis Summary

Location	Period	Movement	Existing				No-Build				Build			
			Demand [a]	v/c [b]	Delay [c]	LOS [d]	Demand	v/c	Delay	LOS	Demand	v/c	Delay	LOS
Lake Avenue North at North Road	Weekday Morning	EB – L	15	0.13	37	E	15	0.18	51	F	35	*	*	F
	Weekday Evening	EB – L	90	0.71	73	F	90	1.04	177	F	130	*	*	F
Lake Avenue North at Northerly u-turn/Regatta Point	Weekday Morning	WB – LR	neg	0.02	15	B	neg	0.03	17	C	neg	0.03	21	C
	Weekday Evening	WB – LR	15	0.04	11	B	15	0.05	11	B	15	0.05	12	B
Lake Avenue North at South Road	Weekday Morning	EB – R [e]	45	0.10	12	B	45	0.11	13	B	25	*	*	F
	Weekday Evening	EB – R [e]	275	0.62	23	C	275	0.72	32	D	50	*	*	F
Lake Avenue North at Southerly u-turn/Shaw Building	Weekday Morning	EB – LR	10	0.05	14	B	10	0.06	16	C	10	0.09	24	C
	Weekday Evening	EB – LR	30	0.11	17	C	30	0.14	21	C	30	0.25	37	E

a demand in vehicles per hour for unsignalized intersections; the demand applies to only the most critical lane group
b volume-to-capacity ratio for the critical movement
c delay of critical approach only, typically the left-turn movement
d level of service of the critical movement
e EB – L in the build condition
L left-turn movement
R right-turn movement
LR shared left-turn/right-turn movement
LTR shared left/through/right movement
neg negligible volume
* v/c ratio exceeds 1.2 and/or delay exceeds 180 seconds

The analysis indicates that the Lake Avenue North at North Road intersection operates near or over capacity under existing conditions and is expected to worsen significantly under the No-Build conditions. The poor existing traffic operations are likely due to heavy traffic volume on the northbound/southbound movements, which reduces the number of available gaps for the traffic on the side street, stop-controlled approach. The increases in delay can be attributed to the ambient background growth of traffic on the mainline, traveling past the site. Lastly, as one would expect, the intersection's operations are expected to worsen in the Build condition with the introduction of site-generated traffic.

The analysis also indicates that the Lake Avenue North at South Road intersection operates at LOS B/D or better under the Existing and No-Build conditions. The intersection's operations are expected to worsen significantly with the introduction of site-generated traffic.

It should be noted that the traffic analyses models are less accurate at high ranges of v/c ratio and delay. This is due to the exponential relationship used in the formulae to calculate v/c ratios and delay. Additionally, it has been documented that, "... once demand exceeds 80 percent of capacity, modest increases in demand can cause significant increases in delay..."[4] Examples of this are delays that exceed 180 seconds, or three minutes of delay. Although the traffic analysis models report delays that exceed 180 seconds for various locations, these delay measurements are not accurate as the v/c ratios and demands increase.

Future Area Transportation Infrastructure Deficiencies

As previously noted, several intersections throughout the study area are currently operating at sub-optimal levels. With the addition of either background traffic growth or site-generated traffic as part of the UMMS/UMMHCS Mater Plan project, these intersections' operations are expected to worsen, as well as potentially degrading the operations at other study area intersections.

In addition to the already strained intersections, Lake Avenue North at North Road and Lake Avenue North at South Road are anticipated to operate poorly due to the increase of site-generated traffic. The reported estimated delays appear worse than what could be expected, since they are unsignalized intersections [as previously described].

These locations are presented graphically in Figure 17. Discussions of the recommended transportation infrastructure improvements are presented later in this document.

[4] 2000 Highway Capacity Manual, Transportation Research Board – National Research Council, Washington, D.C. [2000]; chapter 16, p. 16-24

Traffic Signal Warrant Analysis

The Manual on Uniform Traffic Control Devices [MUTCD][5] lists specific criteria, or warrants, for the consideration of installation of a traffic signal at an intersection. The MUTCD also notes that, "the satisfaction of a traffic signal warrant or warrants shall not, in itself, require the installation of a traffic control signal." The traffic signal warrant analysis provides *guidance* as to locations where signals would not be appropriate and locations where they could be considered further.

Traffic signal warrant analyses for two volume-based warrants [warrant 2: four-hour vehicular volume; and warrant 3: peak hour volume] are summarized in Table 13. The warrant analysis results were taken into consideration when developing the transportation infrastructure improvement recommendations, discussed in the next section.

Table 13
Traffic Signal Warrant Analysis Summary

Location/Warrant	Existing		No-Build		Full Build	
	Morning	Evening	Morning	Evening	Morning	Evening
Lake Avenue North at South Road						
Warrant 2: 4-Hour Volume	no		no		no	
Warrant 3: Peak Hour Volume	no	no	no	yes	no	yes

As shown, the intersection of Lake Avenue North at North Road would warrant a traffic signal once the development of the campus reaches its full-build potential. More discussion of this need is included in the recommendations section of this document.

[5] MUTCD: *Part 4 – Highway Traffic Signals*, USDOT/FHWA [November 2003]

5

Recommended Transportation Improvements

The development program will represent a significant generator of transportation activity in terms of vehicular traffic, parking need, pedestrian activity, and public transportation use near the campus. Accordingly, the following program will need to be considered as the project advances to a more detailed stage. This improvement program addresses the specific impacts of the development program; improves the UMMS/UMMHCS campus' management of its current transportation facilities; and strives to reduce its impacts on the operation of the transportation system serving the campus. This improvement program is described below.

Transportation Demand Management Program

The UMMS/UMMHCS campus currently provides several transportation demand management [TDM] programs and strategies for its visitors and staff. Several of these programs are currently in place and are being utilized regularly, while others are less utilized. As part of this planning program, VHB recommends that several different TDM initiatives be considered.

- **Coordinate with Transit Authorities** – UMMS/UMMHCS should highlight and aggressively market its efforts to provide service by any number transit providers. These should specifically focus on providing services provided by the Worcester Regional Transit Authority [WRTA]. Monthly passes should be available to the regular staff and students at discounted prices. Coordination with the WRTA to bring bus service directly into the site via South Road should be explored.

- **Develop a Formalized Ride-Matching Program** – UMMS/UMMHCS should participate in a formalized ride-matching program that will provide resources intended to promote carpooling for faculty, students, and staff of the campus.

- **Develop Carpooling Incentives** – UMMS/UMMHCS should provide various incentives aimed at encouraging carpooling by students, faculty, and staff. Preferred parking spaces, parking discounts, and other promotional ideas are samples of ideas that should be explored.

- **Designate a Transportation Coordinator** – UMMS/UMMHCS should designate one central point of contact for transportation issues that students, faculty, and staff can contact to answer day-to-day questions about transportation issues. This individual would be responsible for providing public transit, ridesharing, and other transportation information in one centralized location.

- **Consider Intelligent Transportation Systems Initiatives** – UMMS/UMMHCS should provide transportation information on an internet site to inform visitors on the most logical traffic directions to and from the site depending on their ultimate destination. This site could also be used to inform commuters of construction activities and parking issues ongoing and planned throughout the site. Variable message boards should be erected to inform visitors and staff of construction activities.

Pedestrian and Bicycle Enhancements

As described earlier, there is a particular desire to enhance both the on-site and off-site pedestrian environment in the vicinity of the campus. While the pedestrian environment on campus has seen dramatic improvements over the past several years, the continued development of the campus will provide many more opportunities to improve pedestrian connections.

Specifically, connections between the parking facilities and buildings that they serve should provide covered walkways wherever possible and be enjoyable from an aesthetic perspective. To promote lively and safe pedestrian activity around and throughout the campus, the following actions should be implemented:

- extend the sidewalk on the southerly side of North Road all the way to Lake Avenue North
- provide a crosswalk across Lake Avenue North at the North Road/ Lake Avenue North intersection
- extend the sidewalk on the westerly side of Lake Avenue North south to meet the existing sidewalk
- connect the two segments of existing sidewalk along the northerly side of Route 9 on the southerly side of the site
- provide sidewalks on the northerly and southerly sides of South Road, from Plantation Street to Lake Avenue North
- provide at least two crosswalks at the South Road/Lake Avenue North intersection
- repair or construct the sidewalk along the southerly side of Route 9, creating a contiguous sidewalk connection in front of the entire site

Previous Traffic Signal Improvements

Specific corrective measures were identified in the previous MEPA filing for this site [July 2003 ENF] to address existing deficiencies as well as accommodate future background growth, independent of the proposed project. These improvements provide limited short-term improvements to the intersection operations. These corrective measures include actions for the signalized intersections of Belmont Street at Lake Avenue, Belmont Street at Plantation Street, and Belmont Street at Shrewsbury Street, and are included in the appendix of this document for review.

Roadway Infrastructure Improvements

While the transit and pedestrian improvements will serve to off-set some of the impact of vehicular traffic on area roadways, it is expected that a significant impact on area intersections resulting from the development of the Master Plan would remain. As shown previously, the addition of site-generated traffic to the study-area intersections will have a significant impact on the study-area roadways and intersections in the absence of any improvements. The following six intersections have been identified as being directly impacted by the changes associated with the UMMS/UMMHCS campus development plan:

- South Road at Plantation Street
- South Road at Lake Avenue
- Belmont Street [Route 9] at Shrewsbury Street
- Belmont Street at Plantation Street
- Belmont Street at Lake Avenue
- Boston Turnpike [Route 9] at Quinsigamond Avenue

Potential improvements at all six locations are described in the following sections.

South Road at Plantation Street

This intersection currently serves as the 'front door' to the UMMS/UMMHCS campus. With the added development occurring predominantly on the southerly side of the campus, this intersection will accommodate the majority of the vehicular traffic volumes. To address the impact of the additional traffic loads on this intersection, South Road will need to be upgraded to provide an additional left-turn lane exiting the site. Additionally, a northbound right-turn lane to South Road should be provided as part of the long-term build-out of the site.

The specific timing of these improvements should occur as the site is developed. While they are not necessary in the short-term, they will be needed as the campus becomes more occupied.

South Road at Lake Avenue

As the campus starts to develop, particularly in the southeastern quadrant, the traffic volumes arriving at and departing the campus along Lake Avenue will increase. As a result, the traffic volumes entering and exiting the campus from Lake Avenue at South Road will begin to increase as well. Currently, South Road is not considered a major access point for visitors to the hospital campus because of the somewhat disjointed makeup of Lake Avenue.

To both traffic impacts away from both the main campus entrance at South Road and Plantation Street, upgrades should be considered to this intersection as a secondary access point into and out of the campus. Discussions with the campus development team indicate that a traffic signal and realignment of the Lake Avenue corridor at this location has been considered in the past and would be a benefit to the long-term development of the campus. This signal will also improve the pedestrian environment along Lake Avenue by providing a safe crossing to and from the activities located along Lake Quinsigamond.

This improvement has been discussed with MassHighway as part of the July 2003 ENF for the Campus Modernization Program. Since then, the proponent and MassHighway have been engaged in on-going discussions relating to the South Road alignment, as well as this access consolidation.

In addition to physical improvements at this location, improved signage promoting this driveway as a secondary means of access should be posted near the site to advise UMMS/UMMHCS-related motorists of this access point.

Belmont Street [Route 9] at Shrewsbury Street

As previously noted, the westbound approach is marked poorly. This intersection would benefit from improved lane designations and signage to clearly mark where drivers should be when they travel through the intersection. This intersection is projected to carry approximately 15 percent of the new peak hour vehicle trips as part of the full build-out of the development plan.

While adequate long-term physical capacity will be present at this intersection once the Master Plan is developed, there are several inefficiencies in the signal that need to be addressed. This traffic signal should be hard-wire interconnected and coordinated with other, nearby signalized intersections along Shrewsbury Street to improve the traffic flow between these locations. This improvement would reduce the need for motorists to continually stop at successive signals as they travel along the Route 9 corridor.

■

Belmont Street [Route 9] at Plantation Street

This intersection will serve as the primary access point off Route 9 for the development. As such, it will experience the majority of the off-site traffic impact loading. Without any improvement measures in place, this intersection is projected to operate over capacity during the peak periods. Therefore, as the campus is developed, it will be necessary to improve the capacity of the intersection through the addition of new turning lanes at the intersection. The following intersection improvements should be considered.

- Add a second left-turn lane on Route 9 heading into Plantation Street to accommodate the increase in left-turn demand resulting from the campus development.
- With the development of a second major access point off of Lake Avenue to the south, there may be a shift in traffic volumes away from this intersection and to the south along Lake Avenue. Therefore, it is recommended that this location be monitored as the development of the campus takes place. A second eastbound left-turn lane along Route 9 could be considered if and when the volume would warrant such an improvement.

These improvements will likely require additional right-of way along the Route 9 corridor that may or may not be under the control of the UMMS/UMMHCS campus. It is recommended that if these improvements are pursued, a more detailed evaluation of the property impacts should be investigated.

■

Belmont Street [Route 9] at Lake Avenue

With the development and emphasis of a second access point into the main campus off Lake Avenue, there will be a shift in traffic activity to the Lake Avenue corridor. Consistent with this shift will be the need for roadway improvements along both Lake Avenue and at the intersection of Belmont Street at Lake Avenue.

This intersection is currently constrained by a number of issues, most notably the inability to add capacity to the westbound approach to this intersection due to the bridge over Lake Quinsigamond. Assuming that it is infeasible to widen the bridge as part of this effort, the following intersection improvements should be considered.

- Upgrade and coordinate the traffic signal with other locations on Route 9 to improve the efficiency of all the signals along the corridor.
- Widen the southbound Lake Avenue North approach to the intersection to provide an exclusive right-turn lane onto Route 9 westbound [this may require a land donation from the campus to accomplish this improvement].
- Extend the southbound Lake Avenue North left-turn lane approach to accommodate the increased demand.
- Consider a flared right-turn lane from westbound Route 9 to Lake Avenue, which would serve to process this additional demand generated by the Master Plan.

This improvement would provide a minimal level of improvement to this intersection. Additional capacity enhancements will likely need to be investigated as well to offset any traffic impacts at this intersection.

■

Boston Turnpike at Quinsigamond Avenue

Although in Shrewsbury, this intersection currently processes much of the traffic that arrives to the site is expected to process a significant volume of additional traffic resulting from the proposed campus development plan. Similar to the prior intersection of Lake Avenue at Belmont Street [Route 9], this intersection is constrained by the bridge over Lake Quinsigamond.

Several improvements were recently suggested and designed as part of a MassHighway signal and roadway improvement project at this location. These improvements were recently put out to bid and will likely go to construction sometime in mid- to late 2005 or early 2006. These improvements will include a replacement of the traffic signal equipment and coordination with other signalized locations along Route 9 in Shrewsbury, as well as geometric improvements aimed at improving the traffic flow into and out of the various commercial properties near this signal.

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This improvement would provide a minimal level of improvement to this intersection. Additional capacity enhancements will likely need to be investigated as well to offset any traffic impacts at this intersection.

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Despite the improvements mentioned above, there would still be some improvements necessary at this intersection to accommodate the UMMS/UMMHCS development-related traffic. These will likely include the addition of turning lanes at the signal and some land takings around the intersection involving private land owners. These improvements could be constructed in a phased approach as the project advances to help defer some of the capital costs associated with this development, and will need to be discussed with the appropriate regulatory authorities.

Site Circulation

VHB worked with the site architect to design the internal site roadways in such a manner that would promote safe and efficient site circulation. Tight corner radii, unnecessary turns, narrow alleys and circulation routes, and awkward maneuvers were avoided where possible. Wide alleys around buildings were included for emergency access where available. Corner and turning radii that could accommodate ambulances were implemented. Ease of vehicular flow from one area of the site to another was also considered.

Parking Management

In addition to the vehicular circulation on and off the site, VHB recommends the implementation of a comprehensive parking inventory management system be implemented on the site. This would include a pass card-type system for employees and students to park in designated lots. Lots closer to the actual hospital buildings would be designated for visitors, especially emergency room-related visitors. Lots farther away should be designated for out-patient care, employees, and students. Covered walkways, via the internal pedestrian system, or a shuttle service should be considered during inclement weather days. In areas where mixed users park, clear designations should be made, with visitor parking on the lower levels of garages or closers areas of lots, and the balance for use by out-patients, students, and employees. If visitors are required to pay for parking, a convenient and standardized ticketing system should be used throughout the campus. Appropriate signage for all types of parking should be used throughout the campus as well, as described in the following section.

Campus Signage

With a significant increase in building space, it is a possibility that visitors to the site could be unfamiliar with the campus layout and could be easily be confused as they travel through the site. Therefore, the campus should have a detailed and standardized signage plan directing visitors, students, and employees alike around and through the campus. These signs will include both text and visual/graphical cues for the various destinations and should also consider those who cannot read English.

At each of the four main intersections to the campus, large, easy to read signs should be posted informing the motorist first to the generalized location of the buildings/departments on the campus, and then to available parking closest to that area. Visual confirmation signs along each roadway will further enhance the drivers' path through the campus. Signs should be posted directing the motorists to other similar-type parking areas in the event that parking areas are temporarily at capacity. During atypical campus events, such as health fairs or conferences, campus personnel will direct motorists to the best available parking areas. Personnel will maintain contact via two-way radios to ensure that each parking area's status is updated and each parking area is best utilized. Pedestrian signage should also be provided along clearly designated routes directing walkers to the most direct route between buildings.

Exiting the site, directions to the 'best routes' will be identified, such as Route 9, I-290, I-90, and I-495. Other signs, such as signs leading to Shrewsbury, downtown Worcester, the police station, and the like, will also be included. Small printed maps detailing similar information will be available inside the main campus buildings, close to the door.

6

Conclusion

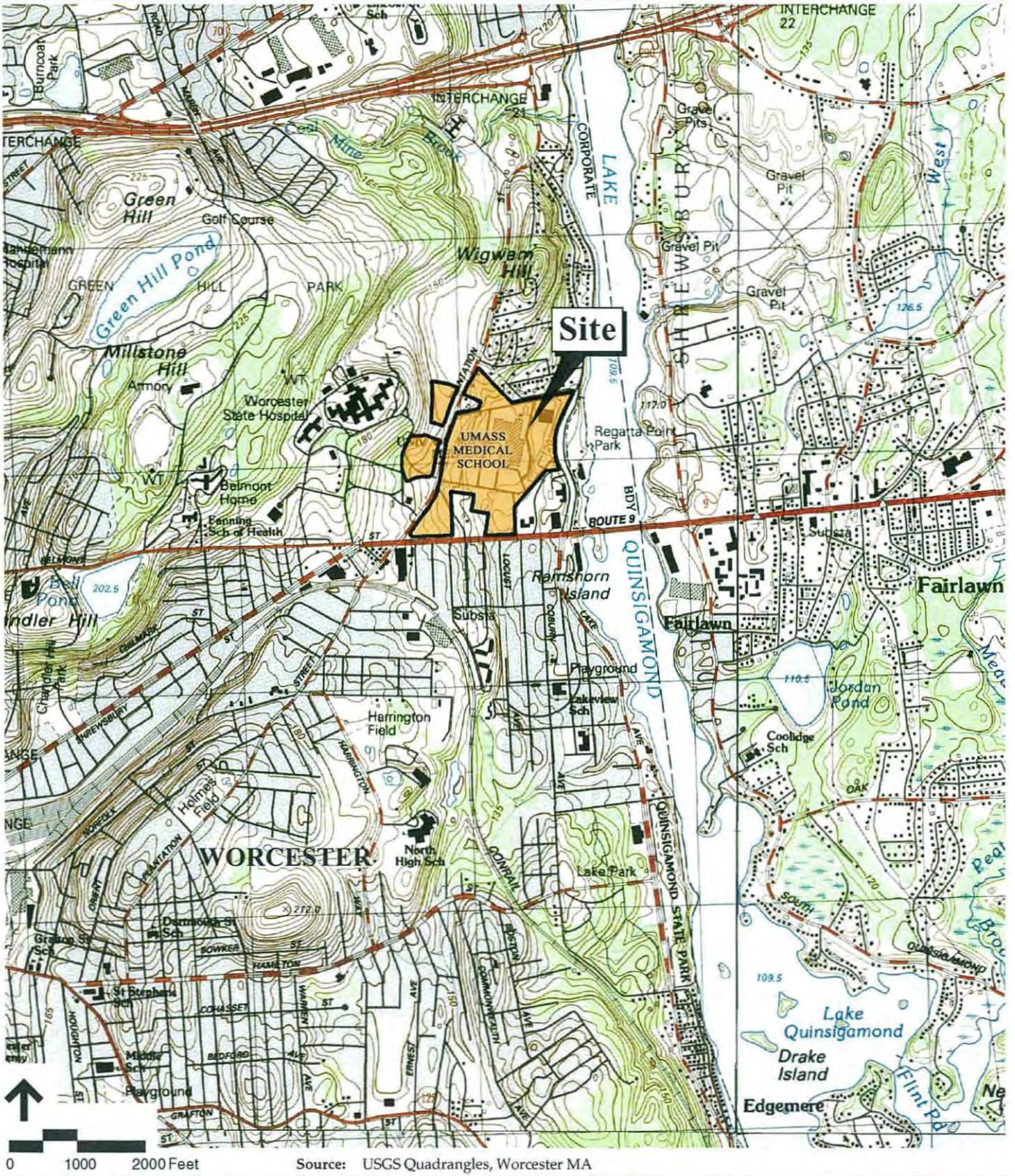
The proposed UMass Medical School/UMass Memorial Health Care System Master Plan project is anticipated to expand the campus by approximately 1,880,000 sf and approximately 7,431 new parking spaces. This would result in approximately 13,780 new daily trips, including 1,500 new vehicle trips during each weekday morning and weekday evening peak hour.

Intersection capacity analyses were conducted for the Existing, No-Build, and Full Build traffic conditions. Field investigations and analysis indicates that *existing* traffic operational deficiencies are present at some of the signalized study area locations. The introduction of ambient background traffic, as well as site-generated traffic, will have a significant impact on study area intersections' traffic operations.

This study has outlined a number of non-physical and physical improvements aimed at addressing the traffic impacts of the proposed UMMS/UMMHCS campus development on area roadways. These improvement plans should be reviewed and coordinated with local and state regulatory agencies before advancing them to a higher level of design.

With the inclusion of the transportation improvements described above, the updated transportation infrastructure within the study area could accommodate the traffic generated by the proposed UMMS/UMMHCS development plan.

\\mawatr\ts\09288\graphics\figures\9288-site-location-map.p65 2/7/2005



Source: USGS Quadrangles, Worcester MA

Vanasse Hangen Brustlin, Inc.

Site Locus Map

Figure 1

UMMS/UMMHCS
Campus-wide Transportation Master Plan
Worcester, Massachusetts

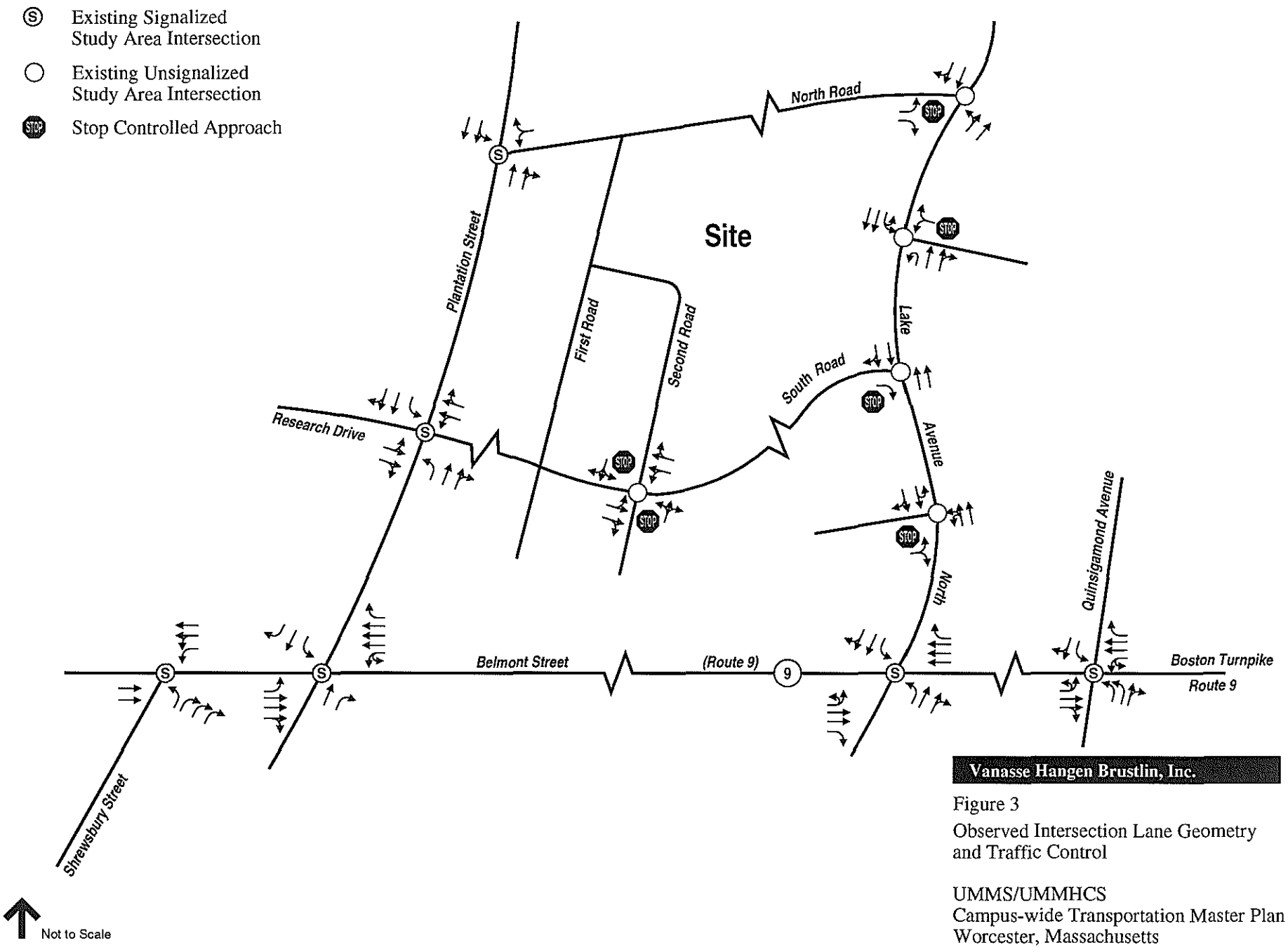


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Figure 3

Observed Intersection Lane Geometry and Traffic Control

UMMS/UMMHCS
Campus-wide Transportation Master Plan
Worcester, Massachusetts

Neg - Negligible

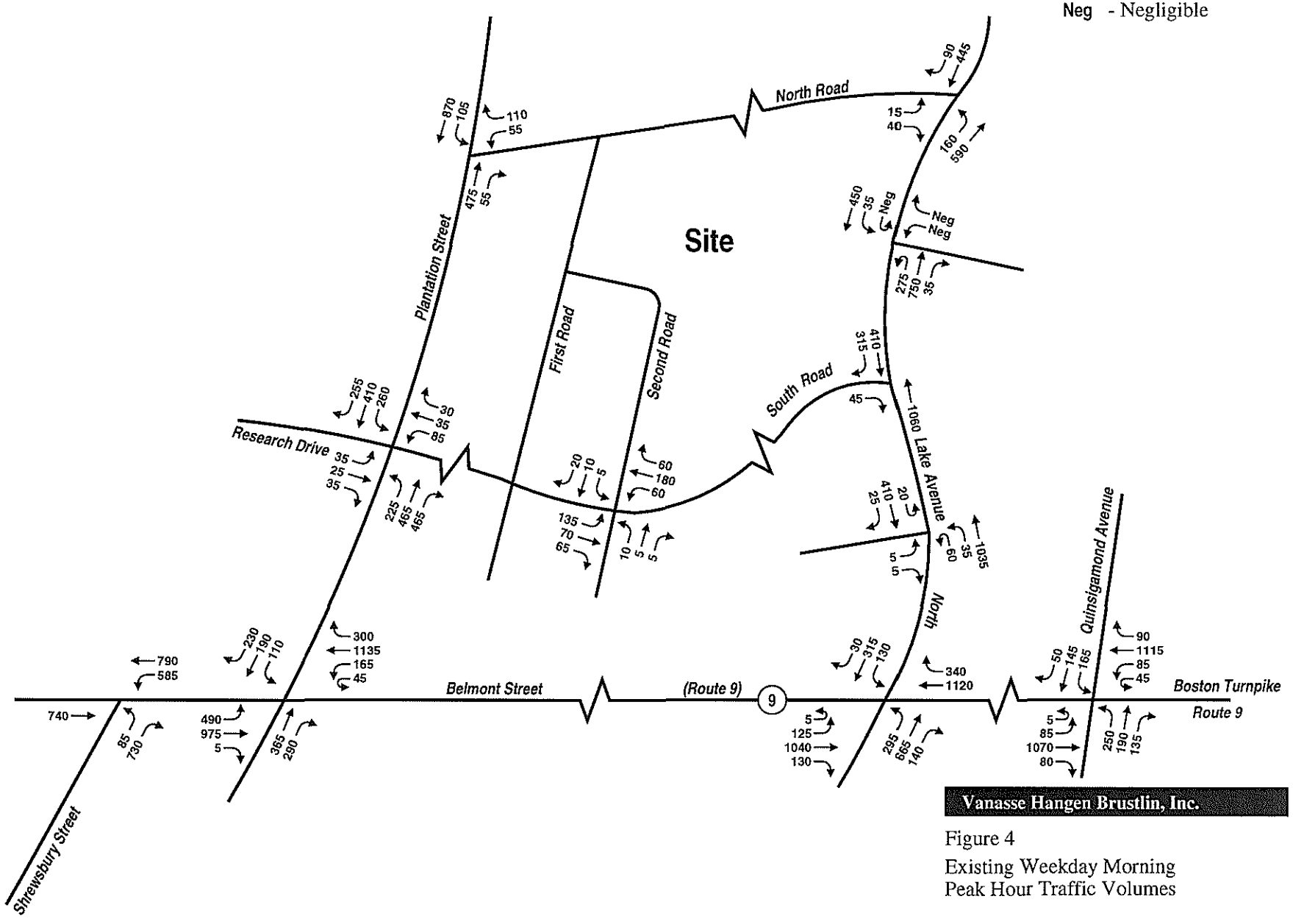

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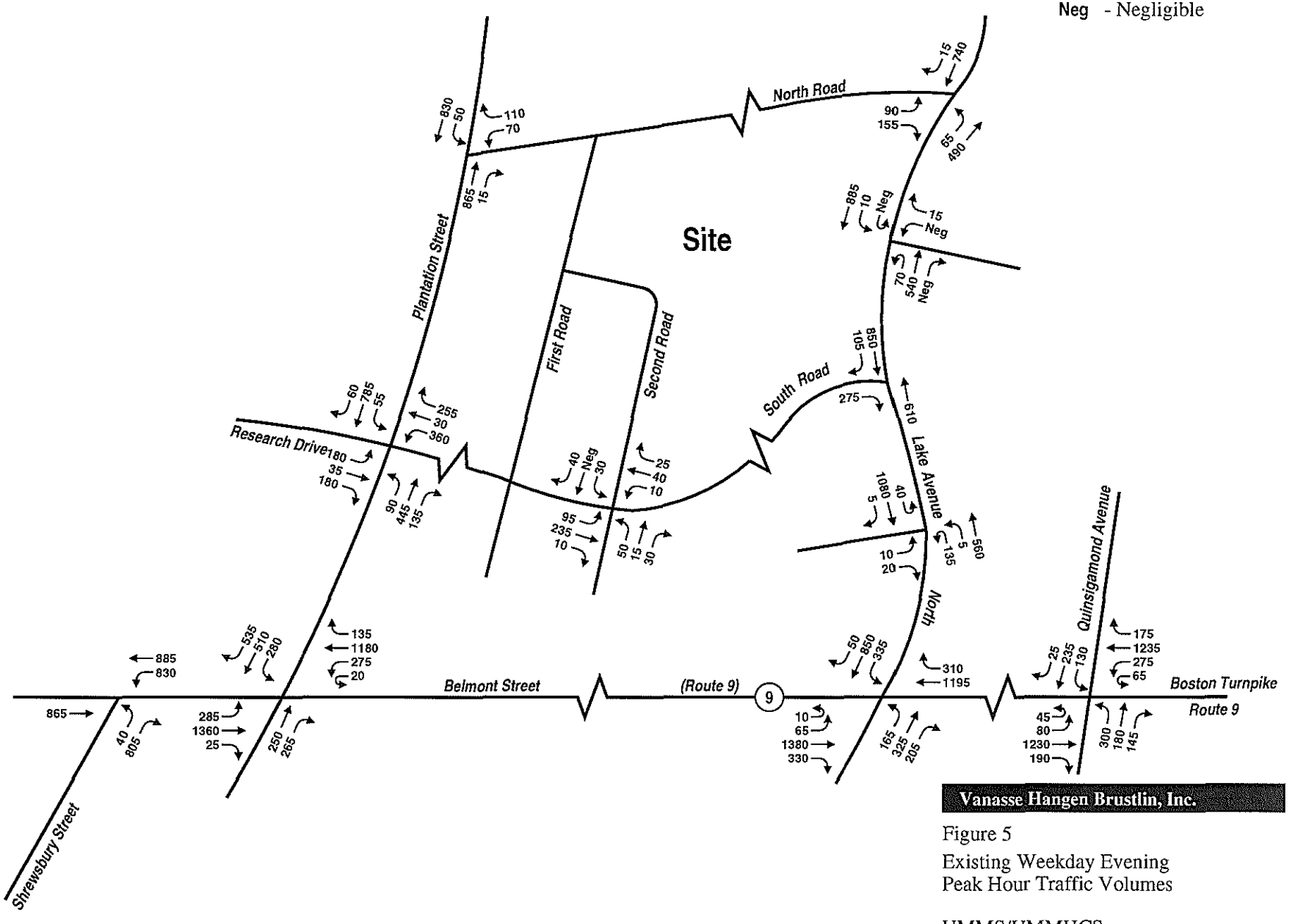
Figure 4
Existing Weekday Morning
Peak Hour Traffic Volumes

UMMS/UMMHCS
Campus-wide Transportation Master Plan
Worcester, Massachusetts

Neg - Negligible



Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 5
Existing Weekday Evening
Peak Hour Traffic Volumes

UMMS/UMMHCS
Campus-wide Transportation Master Plan
Worcester, Massachusetts

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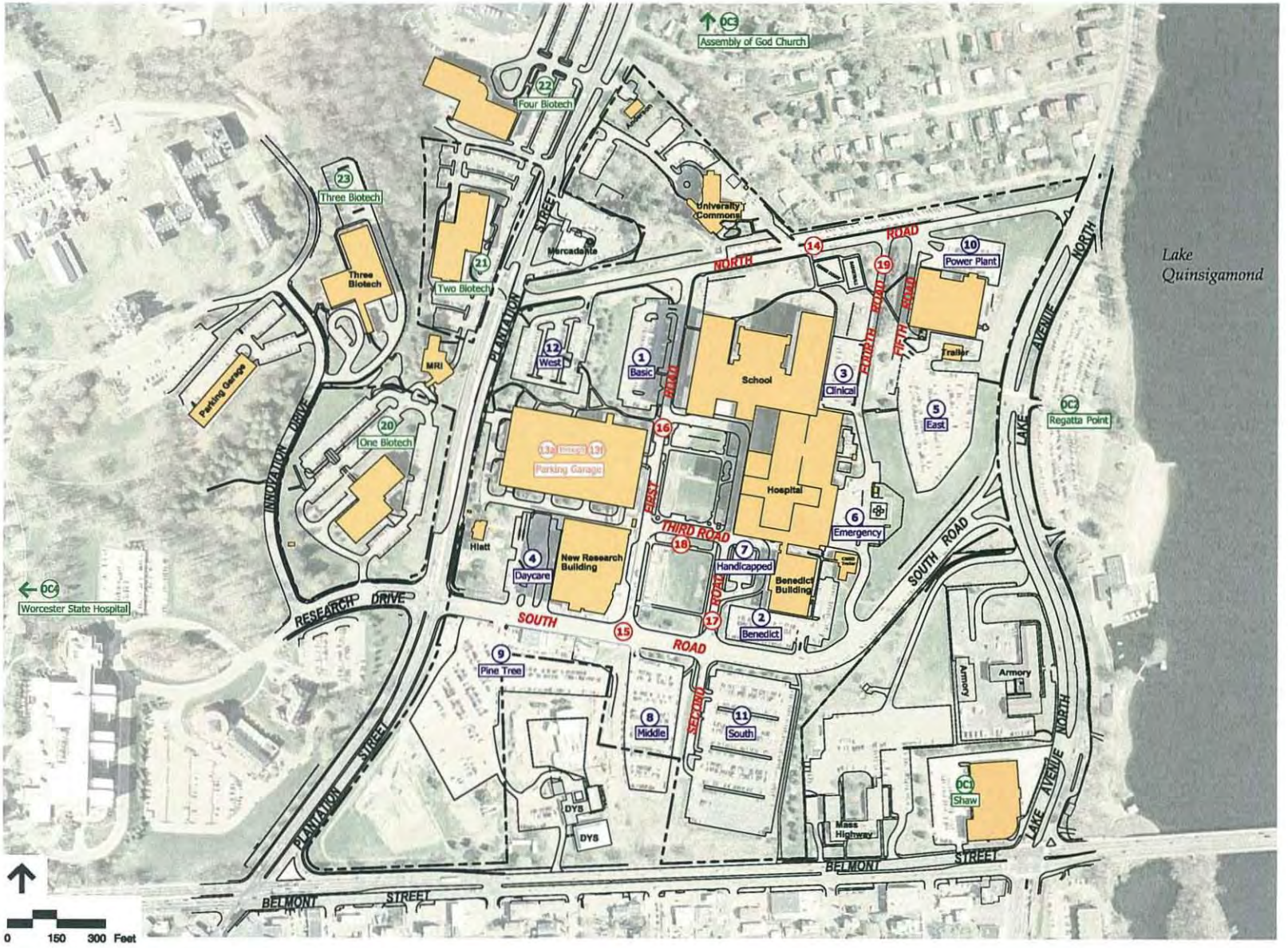

Parking Area	Number of Spaces
Campus Lots	
(1) Basic	126
(2) Benedict	103
(3) Clinical	92
(4) Daycare	15
(5) East	269
(6) Emergency	58
(7) Handicapped	19
(8) Middle	210
(9) Pine Tree	469
(10) Power Plant	43
(11) South	449
(12) West	101
Subtotal:	**1,954**
Existing Parking Garage	
(13e) Level 1	60
(13d) Level 2	202
(13c) Level 3	310
(13b) Level 4	370
(13a) Level 5	259
(13) Level 6	268
Subtotal:	**1,469**
Campus Streets / Street Lots	
(14) North Road	59
(15) South Road	70
(16) First Road	7
(17) Second Road	18
(18) Third Road	8
(19) Fourth Road	8
Subtotal:	**170**
Off-Campus Lots	
(20) One Biotech	205
(21) Two Biotech	183
(22) Four Biotech	101
(23) Three Biotech	48
(OC1) Shaw	144
(OC2) Regatta Point	260
(OC3) Assembly of God Church	300
(OC4) Worcester State Hospital	100
Subtotal:	**1,341**
Campus Total	**4,934**

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Figure 6

Existing Campus Parking Supply
UMMS/UMMHCS
Campus-wide Transportation Master Plan
Worcester, Massachusetts

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Figure 7
Existing Area Pedestrian Pathways

UMMS/UMMHCS
Campus-wide transportation Master Plan
Worcester, Massachusetts

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Figure 8
Existing Area Transportation
Infrastructure Deficiencies
UMMS/UMMHCS
Campus-wide transportation Master Plan
Worcester, Massachusetts

Neg - Negligible

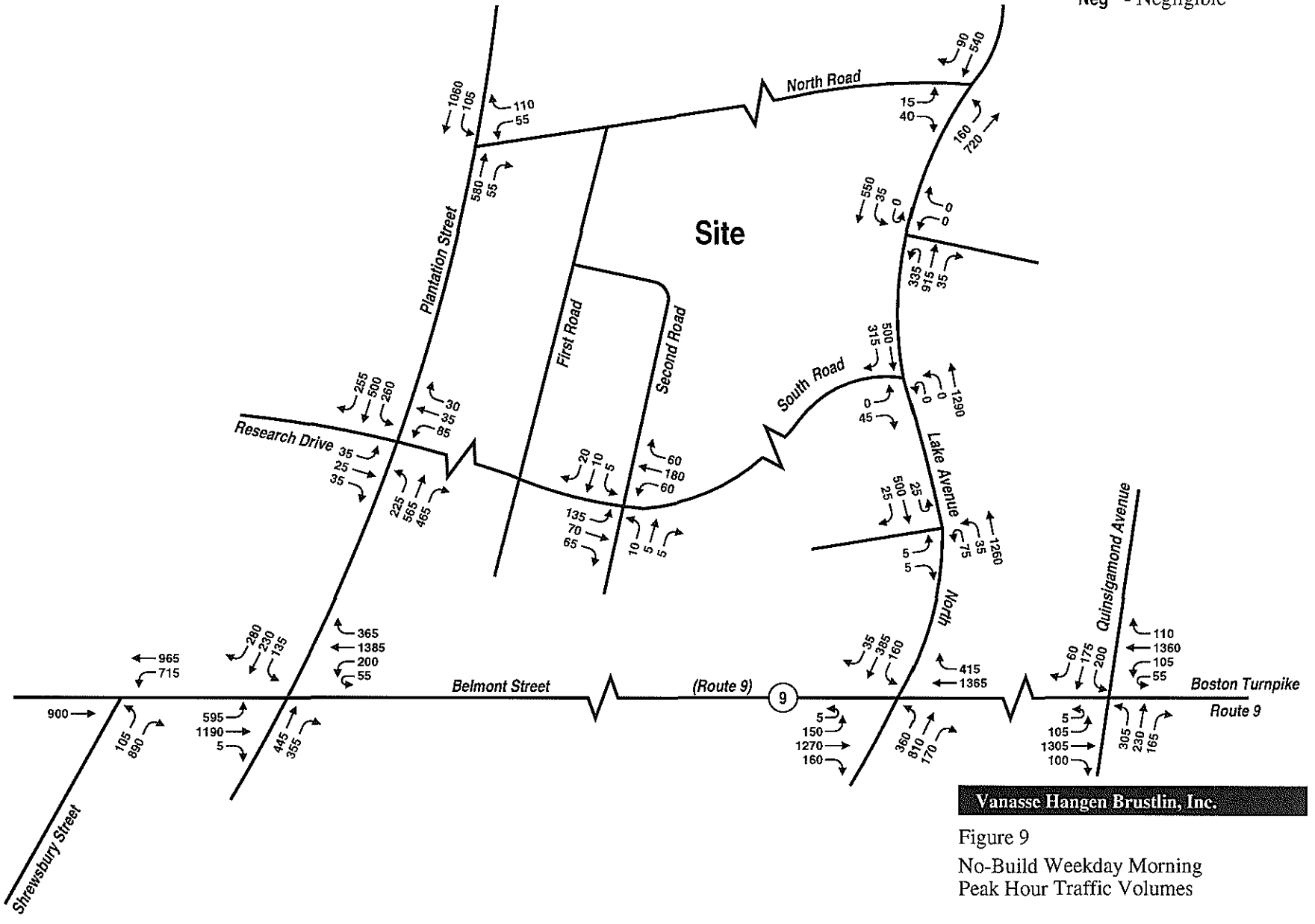

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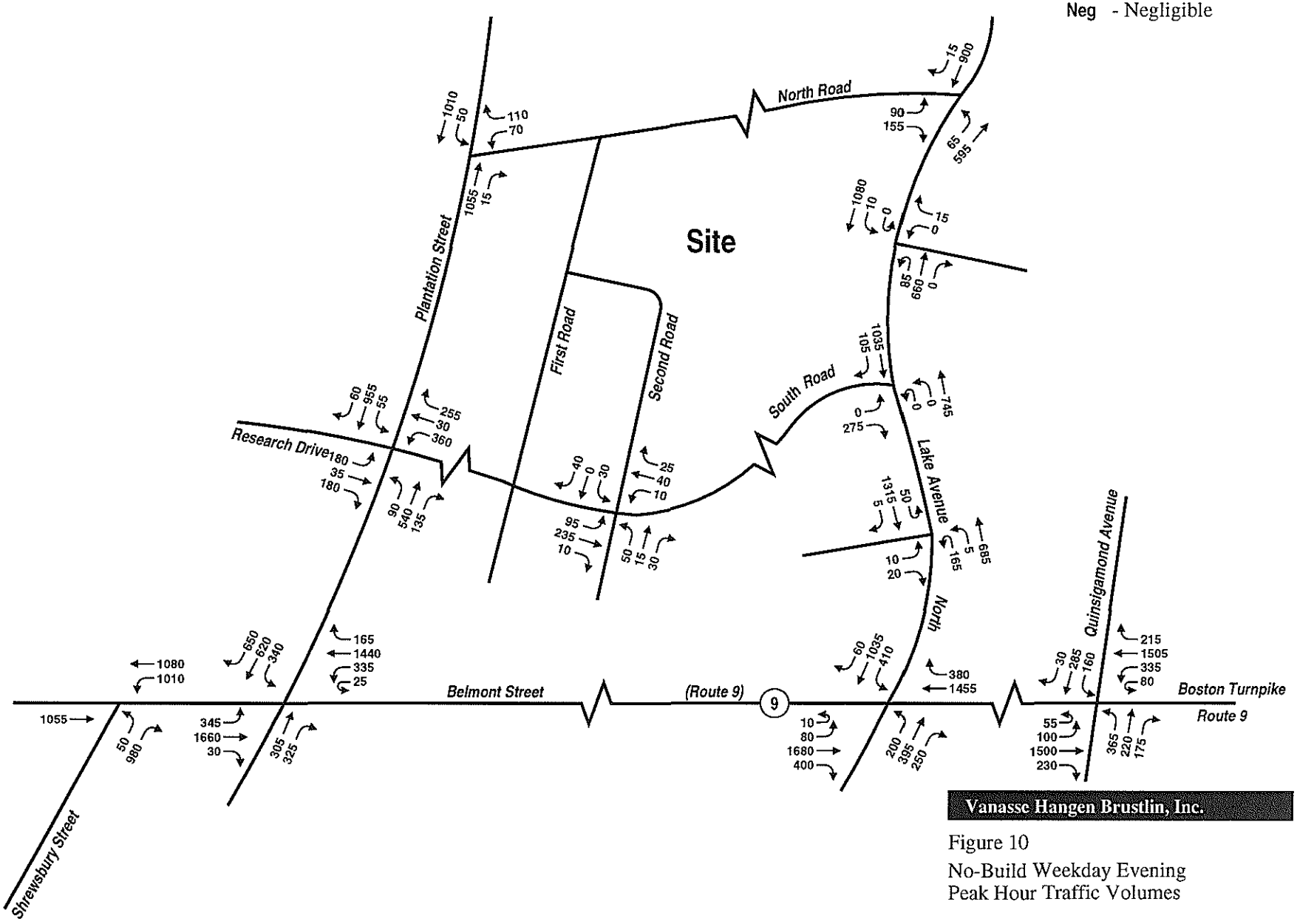
Figure 9
No-Build Weekday Morning
Peak Hour Traffic Volumes

UMMS/UMMHCS
Campus-wide Transportation Master Plan
Worcester, Massachusetts

Neg - Negligible



Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 10
No-Build Weekday Evening
Peak Hour Traffic Volumes

UMMS/UMMHCS
Campus-wide Transportation Master Plan
Worcester, Massachusetts

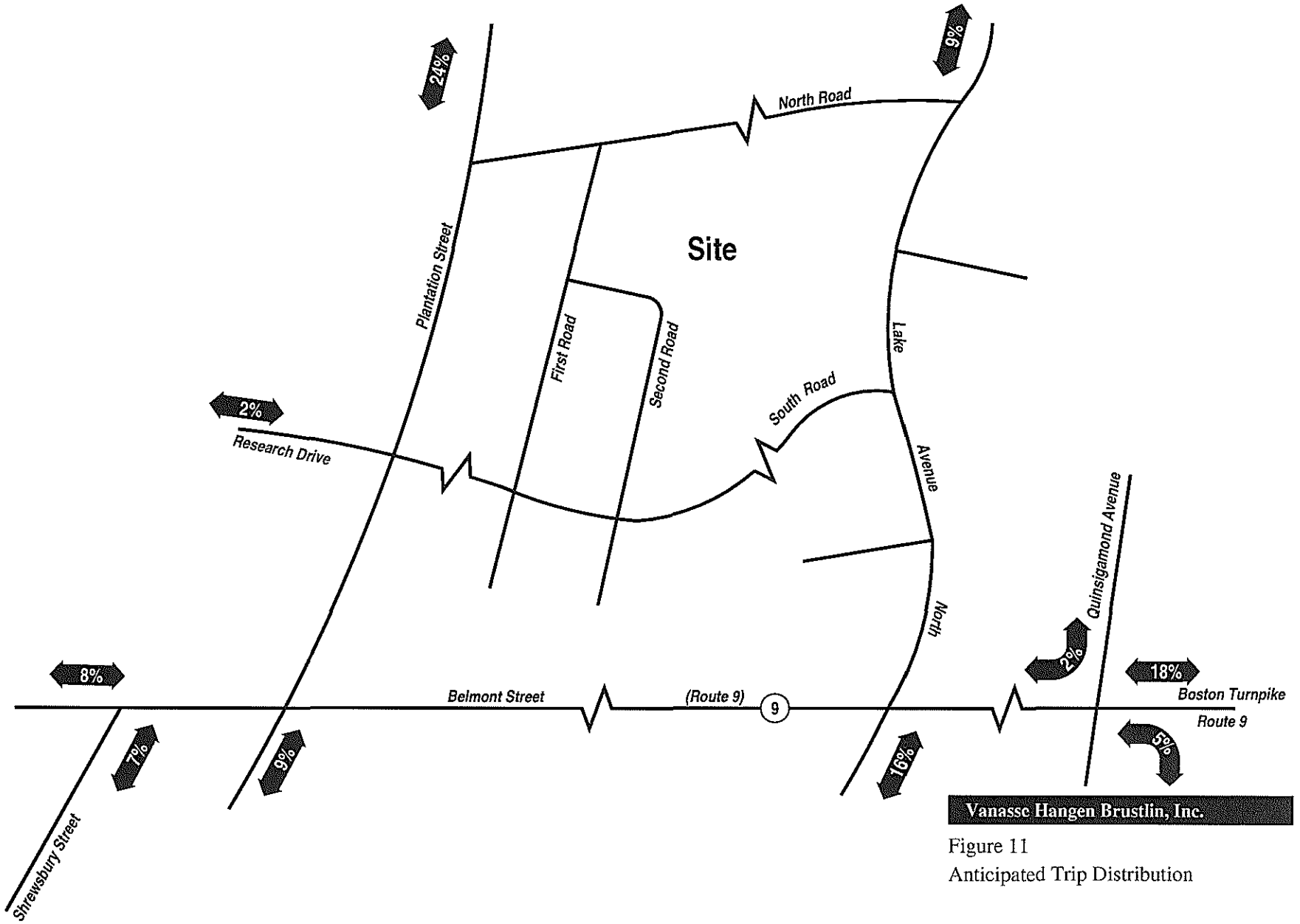


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Figure 11
Anticipated Trip Distribution

UMMS/UMMHCS
Campus-wide Transportation Master Plan
Worcester, Massachusetts

Neg - Negligible

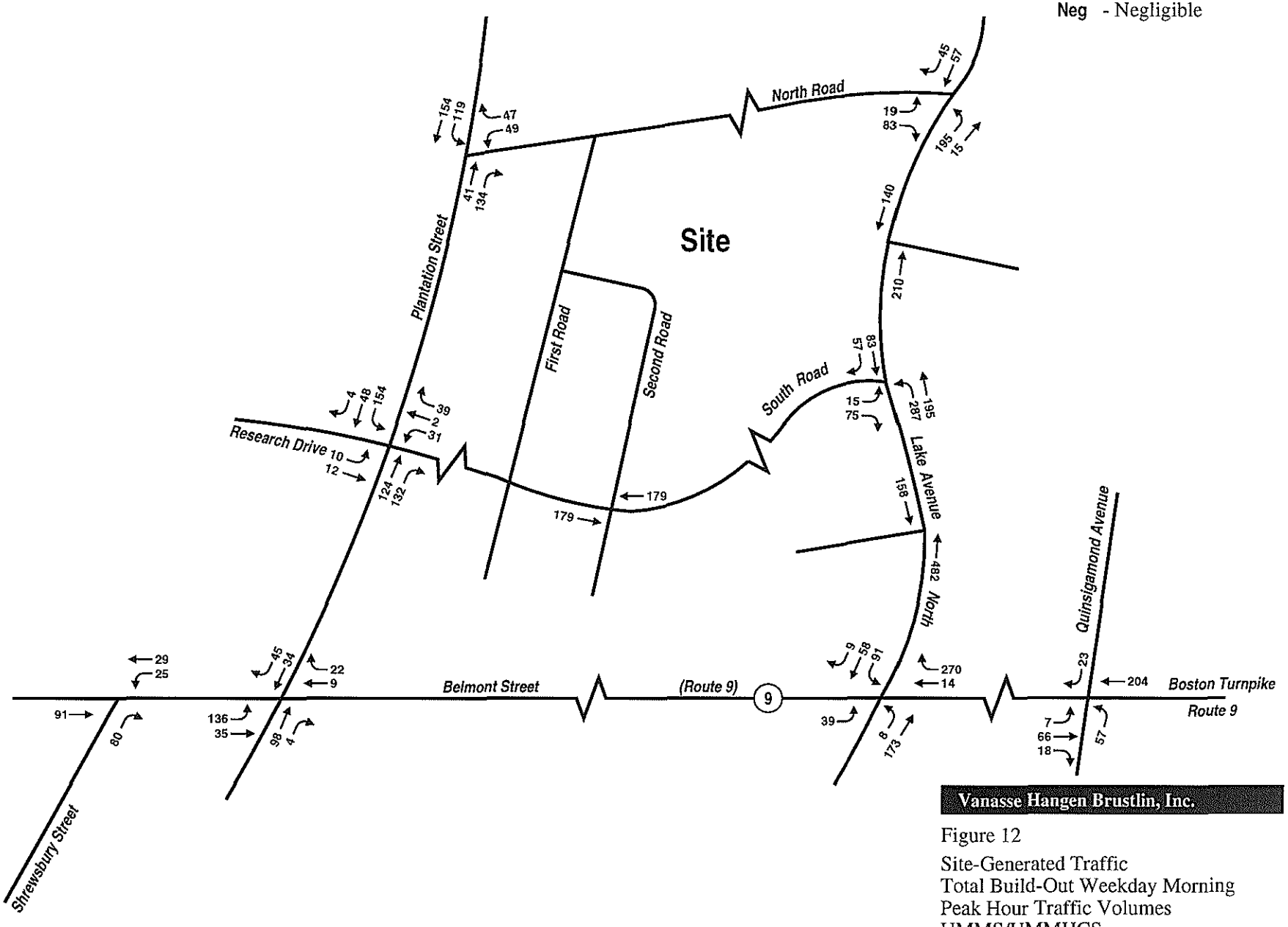

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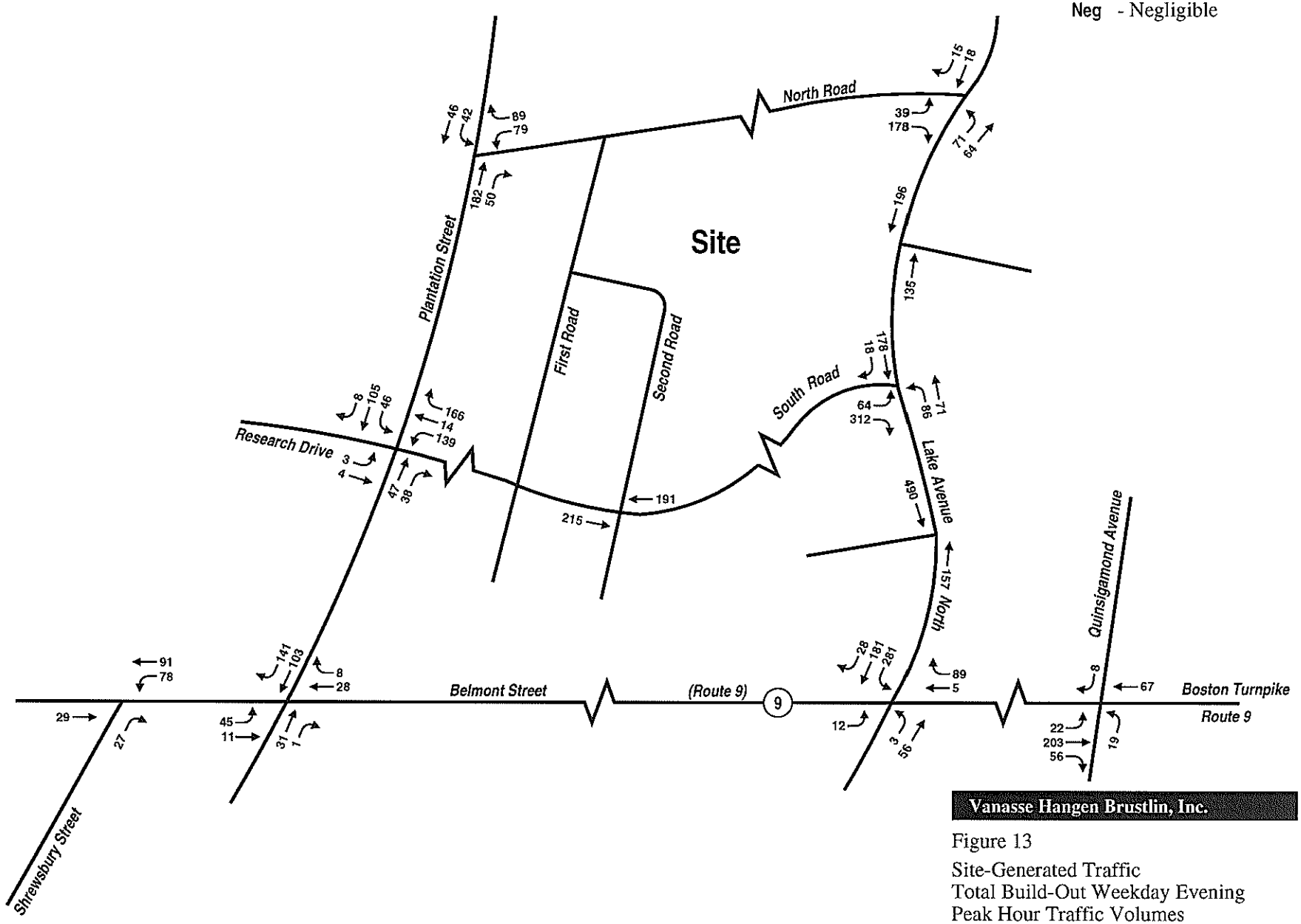
Figure 12

Site-Generated Traffic
Total Build-Out Weekday Morning
Peak Hour Traffic Volumes
UMMS/UMMHCS
Campus-wide Transportation Master Plan
Worcester, Massachusetts

Neg - Negligible



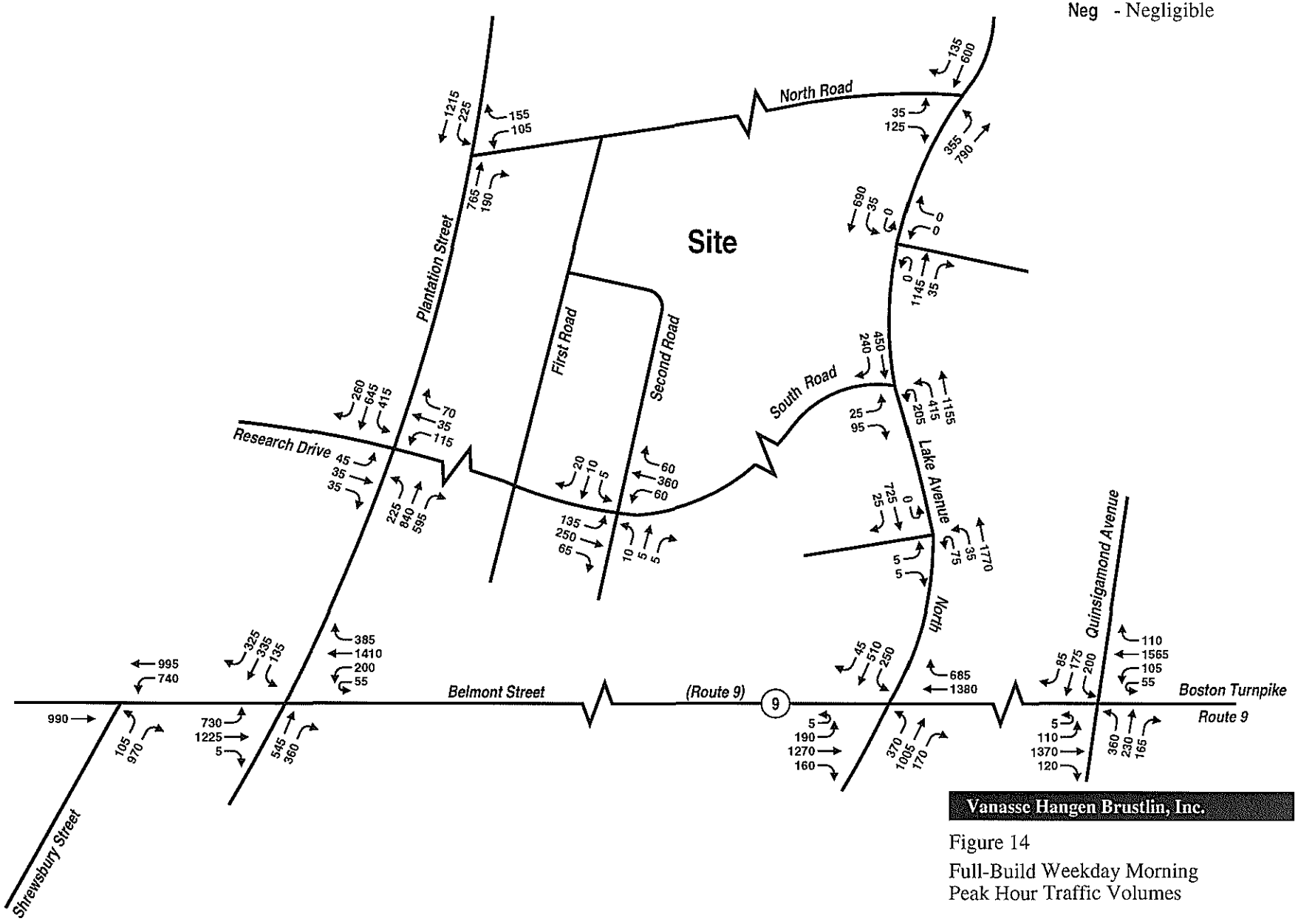
Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 13

Site-Generated Traffic
Total Build-Out Weekday Evening
Peak Hour Traffic Volumes
UMMS/UMMHCS
Campus-wide Transportation Master Plan
Worcester, Massachusetts

Neg - Negligible



Not to Scale

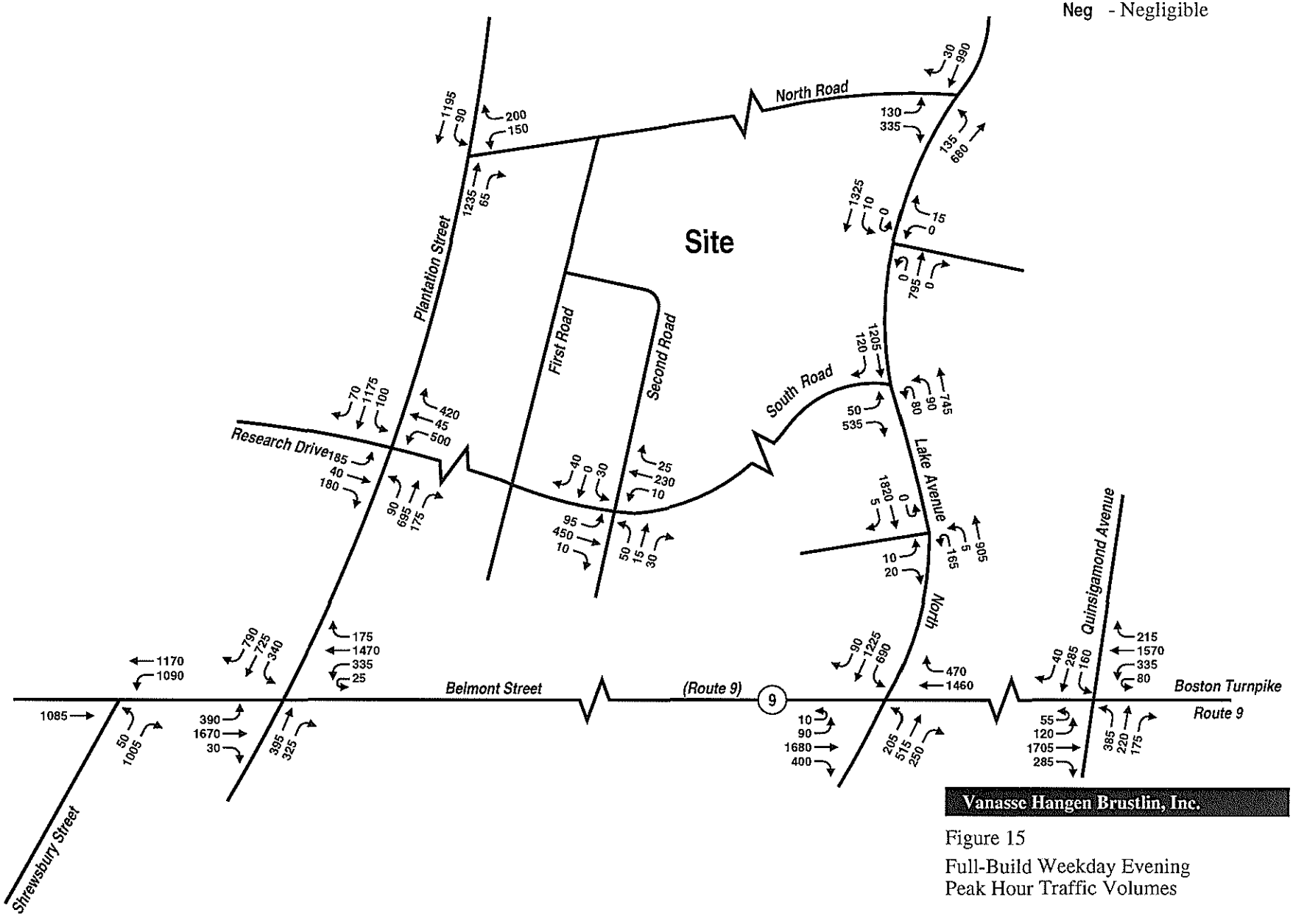
Vanasse Hangen Brustlin, Inc.

Figure 14

Full-Build Weekday Morning
Peak Hour Traffic Volumes

UMMS/UMMHCS
Campus-wide Transportation Master Plan
Worcester, Massachusetts

Neg - Negligible



Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 15
Full-Build Weekday Evening
Peak Hour Traffic Volumes

UMMS/UMMHCS
Campus-wide Transportation Master Plan
Worcester, Massachusetts

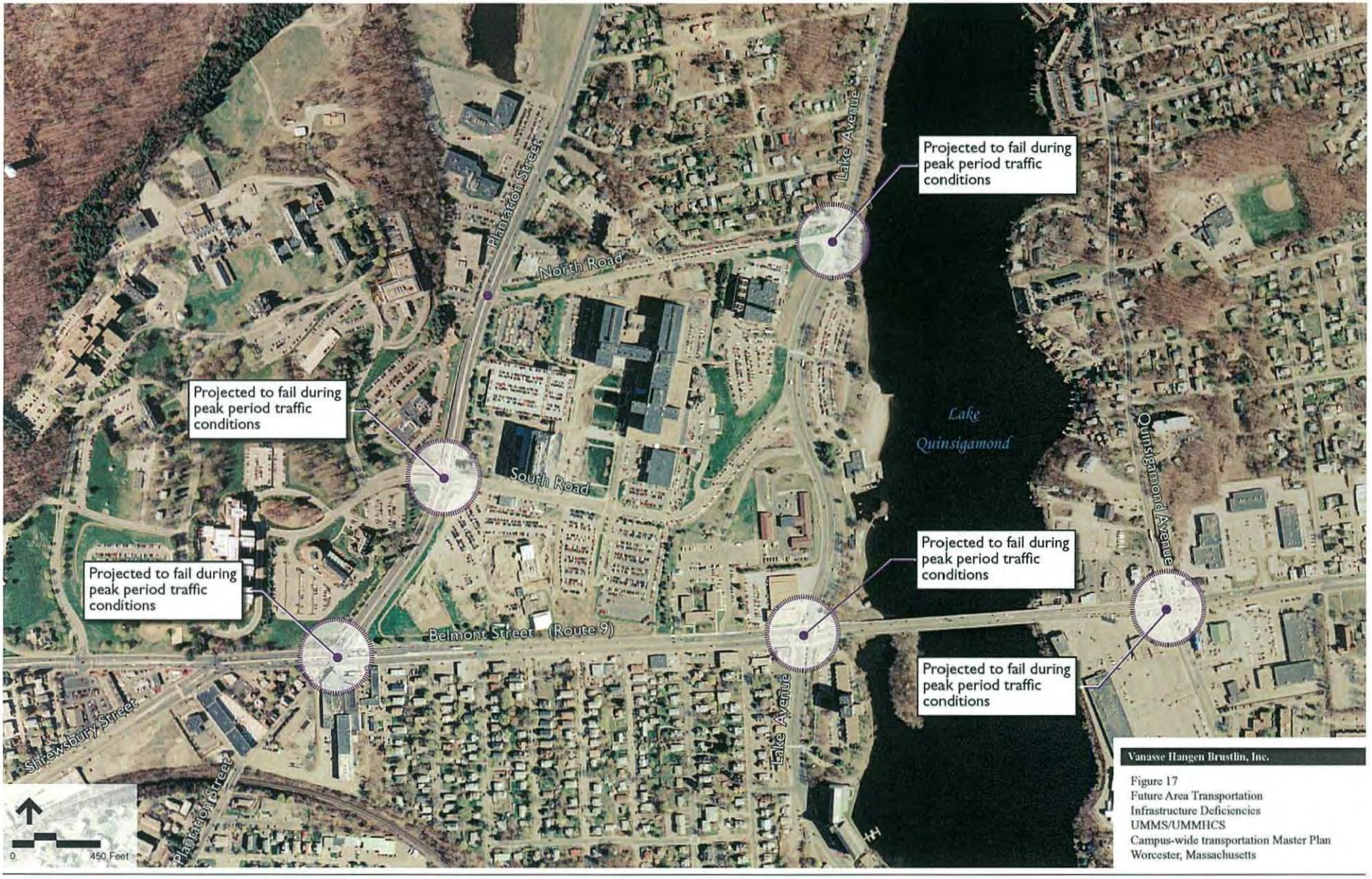


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Figure 17
Future Area Transportation
Infrastructure Deficiencies
UMMS/UMMHCS
Campus-wide transportation Master Plan
Worcester, Massachusetts

Vanasse Hangen Brustlin, Inc.

Figure 18
Recommended Area Transportation Improvements
UMMS/UMMHCS
Campus-wide transportation Master Plan
Worcester, Massachusetts

TSOI / KOBUS & ASSOCIATES

ARCHITECTS

University of Massachusetts Medical School

Section XII. Cost Estimate Scenarios

HANSCOMB Faithful&Gould

Cost Estimate

Tsoi/Kobus & Associates

UNIVERSITY OF MASSACHUSETTS MEDICAL SCHOOL
Worcester, MA

Updated Masterplan Estimate

April 7, 2005

Provided By:
Hanscomb Faithful & Gould
55 Summer Street
Third Floor
Boston, MA 02110
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HANSCOMB
Faithful&Gould

April 7, 2005

Mr. David Owens
Tsoi/Kobus & Associates
One Brattle Square
PO Box 9114
Cambridge, MA 02238-9114

Dear Carol

Re: University of Massachusetts Medical School - Master Plan

Please find enclosed our Updated Construction Cost Estimate for the above referenced project based on masterplan design information dated January 24, 2005, revised in accordance with the new phasing scheme dated September 2005.

	Pricing Date	Estimated Cost
PHASE 1	Summer 2005	$239,990,000
PHASE 2	Summer 2005	$206,520,000
PHASE 3	Summer 2005	$130,230,000
ESTIMATED CONTRACT AWARD		**$576,740,000**

This estimate includes all direct construction costs, general contractor's overhead and profit and design contingency. Cost escalation assumes start dates indicated above.

Excluded from the estimate are: construction contingency, hazardous waste removal, loose furnishings and equipment, architect's and engineer's fees, moving, administrative and financing costs

Bidding conditions are expected to reflect competitive bidding to pre-qualified general contractors, open bidding for sub-contractors, open specifications for materials and manufactures. Should this project be procured through a Construction Manager at Risk (GMP) procurement route then the Estimated Contract Award will be higher.

The estimate is based on prevailing rates for construction in this market and represents a reasonable opinion of cost. It is not a prediction of the successful bid from a contractor as bids will vary due to fluctuating market conditions, errors and omissions, proprietary specifications, lack or surplus of bidders, perception of risk, etc. Consequently the estimate is expected to fall within the range of bids from a number of competitive contractors or subcontractors, however we do not warrant that bids or negotiated prices will not vary from the final construction cost estimate.

If you have any questions or require further analysis please do not hesitate to contact us.

Sincerely,
Hanscomb Faithful & Gould

Gavin English BSc MRICS
Senior Associate

MASTERPLAN COST ESTIMATE

INTRODUCTION

This Construction Cost Estimate was produced from drawings and other documentation prepared by Tsoi/Kobus & Associates and their design team dated January 24, 2005. Design and engineering changes occurring subsequent to the issue of these documents have not been incorporated in this estimate.

This estimate is based upon the measurement of quantities where possible. For the remainder, parametric measurements were used in conjunction with references from similar projects recently estimated by Hanscomb Faithful & Gould.

BASIS FOR PRICING

This estimate reflects the fair construction value for the construction of this project and should not be construed as a prediction of low bid. Prices are based on probable local prevailing union wage construction costs at the time the estimate was prepared, however an escalation line item should be included in the overall project budget to reflect anticipated price increases that will occur between now and the anticipated time of construction. Construction cost escalation is currently running at 7-10% per annum. Pricing assumes a procurement process with competitive bidding for every portion of the construction work, which is to mean a minimum of 4 bids including for all subcontractors and materials/equipment suppliers. If fewer bids are solicited or received, prices can be expected to be higher. **Please note that this estimate assumed competitive bid by general contractors. Should a CM/GMP procurement route be selected then the anticipated contract award will be higher**

Subcontractor's markups have been included in each line item unit price. Markups cover the cost of field overhead, home office overhead and subcontractor's profit. Subcontractor's markups typically range from 5% to 15% of the unit price depending on market conditions.

General Contractor's general conditions' cost is calculated on a percentage basis. General Contractor's overhead and fees is based on a percentage of the total direct (trade) costs plus general conditions, and covers the contractor's bond, insurance, site office overheads, building permit applications, and profit.

We have included a Design Contingency/Design Reserve percentage to cover cost increases that will occur during design elaboration or unforeseen design issues. As the design develops, the design contingency is reduced, and is eliminated at the final Construction Document estimate.

A Construction Contingency is excluded from this estimate. However, in finalizing the project budget, it is recommended that the Owner should add a construction contingency to the Total Estimated Construction Cost in anticipation of change orders likely to occur during construction.

ITEMS NOT CONSIDERED IN THIS ESTIMATE

Items not included in this estimate are:

- Land acquisition, feasibility, and financing costs
- All professional fees and insurance
- Site or existing conditions surveys investigations costs, including to determine subsoil conditions
- Items identified in the design as Not In Contract (NIC)
- Owner supplied and/or installed items (e.g.. draperies, furniture and equipment)
- Tel/data, security and AV networks, equipment or software (unless identified otherwise)
- Rock excavation; special foundations (unless indicated by design engineers)
- Hazardous materials investigations and abatement
- Utility company back charges, including work required off-site
- Work to City streets and sidewalks, (except as noted in this estimate)
- Construction or occupancy phasing or off hours' work, (except as noted in this estimate)
- Owners Construction Contingency for scope changes

MASTERPLAN COST ESTIMATE

ITEMS THAT MAY AFFECT THIS ESTIMATE

Such items include, but are not limited to the following:

- Modifications to the scope of work subsequent to the preparation of this estimate
- Unforeseen subsurface conditions
- Special requirements for site access, off-hour work or phasing activities
- Restrictive technical specifications, excessive contract or non-competitive bid conditions
- Sole source specifications for materials or products
- Bid approvals delayed beyond the anticipated project schedule

STATEMENT OF PROBABLE COST OF CONSTRUCTION

Hanscomb Faithful & Gould requests that the Owner and Architect carefully review this estimate, including all line item descriptions, unit prices, clarifications, exclusions, inclusions and assumptions, contingencies, escalation, and markups to ensure that requirements have been correctly identified. If this estimate does not correspond to the Owner's budgetary objectives, Hanscomb Faithful & Gould strongly suggests that evaluations of other design alternatives/project procurement options should be made before

Hanscomb Faithful & Gould has prepared this estimate in accordance with generally accepted principles and practices to reflect the fair market value of the project. This estimate is made on the basis of the experience, qualifications, and the best judgment of professional consultants who are familiar with the construction industry.

However, Hanscomb Faithful & Gould has no control over the method of determining prices adopted by any individual general contractor, subcontractor or supplier. Hanscomb Faithful & Gould cannot control the cost of labor and materials, the bidding environment or other market conditions, and it is not possible to provide any guarantee that proposals, bids, or actual construction costs will not deviate from this or subsequent cost estimates.

Any requests for modifications to this document must be made to Hanscomb Faithful & Gould within ten (10) days of receipt. Otherwise, it will be understood that the contents are fully concurred with and accepted. Notifications of any apparent errors or omissions should be made to Hanscomb Faithful & Gould as soon as they are discovered.

MASTERPLAN COST ESTIMATE

CONSTRUCTION COST SUMMARY

	PROGRAM ELEMENT	*$/SF*	*GFA*	*TOTAL*
PHASE 1				
Ph 1.1	MEDICAL OFFICE BUILDING - Advanced Clinical Education & Practice Center (ACE & PC)	$155.50	120,000	$18,660,000
Ph 1.3b & c	ABOVE GRADE PARKING w/ POWER PLANT	$46.12	279,710	$12,900,000
Ph 1.3d	PARKING (HOSPITAL EAST SIDE)	$24.98	148,500	$3,710,000
Ph 1.3e	AMBULATORY BUILDING #1	$292.30	100,000	$29,230,000
Ph 1.3e	AMBULATORY BUILDING #2	$294.24	85,000	$25,010,000
Ph 1.3e	AMBULATORY BUILDING #3	$328.64	22,000	$7,230,000
Ph 1.3g	BED TOWER #1	$230.22	135,000	$31,080,000
Ph 1.3g	HOSPITAL SUPPORT	$256.61	127,000	$32,590,000
Ph 1.4a	WORK TO EXISTING PARKING STRUCTURE	$6.61	360,000	$2,380,000
Ph 1.4b	RESEARCH & ACADEMIC BUILDING #1	$286.60	100,000	$28,660,000
Ph 1.4b	RESEARCH & ACADEMIC BUILDING #2	$289.62	78,000	$22,590,000
Ph 1.4b	RESEARCH & ACADEMIC BUILDING #3	$322.78	18,000	$5,810,000
PH1.11	SITE PREPARATION/DEVELOPMENT			$20,140,000
TOTAL PHASE 1		**$152.55**	**1,573,210**	**$239,990,000**
PHASE 2				
PH2.5d	BED TOWERS (OVER EXTG BLDG)	$238.59	135,000	$32,210,000
Ph 2.5c	PARKING (HOSPITAL EAST SIDE)	$47.88	660,000	$31,600,000
PH2.6a	PARKING BELOW PLAZA	$100.09	429,000	$42,940,000
PH2.6a	PARKING AT SOUTHEAST QUADRANT	$45.09	262,350	$11,830,000
Ph 2.6a	PARKING BENEATH BLDG - NW QUADRANT	$64.14	99,000	$6,350,000
Ph 2.6b	RESEARCH BUILDING	$278.68	158,500	$44,170,000
Ph 2.7	RESEARCH & ACADEMIC BUILDING	$283.80	100,000	$28,380,000
PH2.9	SITE PREPARATION/DEVELOPMENT			$9,040,000
TOTAL PHASE 2		**$112.00**	**1,843,850**	**$206,520,000**
PHASE 3				
PH3.1	MEDICAL OFFICE BUILDING	$195.91	22,000	$4,310,000
PH3.2	ACE & PC	$286.11	175,000	$50,070,000
PH3.3	OFFICE BUILDING #1	$182.10	100,000	$18,210,000
PH3.4	OFFICE BUILDING #2	$182.10	100,000	$18,210,000
PH3.5	OFFICE BUILDING #3	$197.20	50,000	$9,860,000
PH3.6	PARKING ABOVE GRADE	$42.99	387,750	$16,670,000
PH3.6	PARKING ABOVE GRADE	$42.93	99,000	$4,250,000
PH3.7	SITE PREPARATION/DEVELOPMENT			$8,650,000
TOTAL PHASE 3		**$139.47**	**933,750**	**$130,230,000**
ESTIMATED CONTRACT AWARD (in 2005)		***$132.56***	***4,350,810***	***$576,740,000***

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
Ph 1.1	*MEDICAL OFFICE BUILDING - Advanced Clinical E*	120,000	sf gfa				
PH1.1.1	**TRADE COSTS**						
	Foundations						
	Strip footings	846	lf	200.00	169,200		
	Column footings	52	ea	1,000.00	52,000		
	Slab on grade	30,000	sf	5.50	165,000		
	Elevator pit	2	ea	15,000.00	30,000		
	Superstructure						
	New structure	60,000	sf	23.00	1,380,000		
	Exterior closure						
	New brick exterior façade	30,794	sf	38.00	1,170,172		
	New windows	811	sf	60.00	48,660		
	New entrance	200	sf	80.00	16,000		
	Roofing						
	New roofing	30,000	sf	20.00	600,000		
	Interior construction						
	Partitions	120,000	sf gfa	10.00	1,200,000		
	Doors	400	lvls	1,100.00	440,000		
	Specialties and casework	120,000	sf gfa	4.00	480,000		
	Staircase						
	New egress staircases, complete	9	flt	17,000.00	153,000		
	Interior finishes						
	Floor finishes	120,000	sf gfa	3.50	420,000		
	Wall finishes	120,000	sf gfa	2.00	240,000		
	Ceiling finishes	120,000	sf gfa	3.00	360,000		
	Conveying						
	New elevator	8	stps	22,000.00	176,000		
	Plumbing						
	New plumbing installation, complete	120,000	sf gfa	5.00	600,000		
	Fire protection - assumed required	120,000	sf gfa	3.00	360,000		
	HVAC	120,000	sf gfa	30.00	3,600,000		
	Electrical	120,000	sf gfa	16.00	1,920,000		
	Furnishings and equipment						
	Entrance mats and window treatment	120,000	sf gfa	0.35	42,000		
	Special construction - "green" design	120,000	sf gfa	3.42	410,400		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See Sitework below		
	Utility Connections						
	New sanitary connections	1	ls	15,000.00	15,000		
	New electrical service	1	ls	15,000.00	15,000		
	New water service	1	ls	10,000.00	10,000		
	New storm water	1	ls	12,000.00	12,000		
	New gas service	1	ls	7,500.00	7,500		
	SUBTOTAL					$14,091,932	
PH1.1.2	**MARKUPS**						
	General Conditions	8.0%		14,091,932	1,127,355		
	Insurance & bond	1.50%		15,219,287	228,289		
	Permit	1.00%		15,447,576	154,476		
	Overhead & profit/fee	4.00%		15,602,052	624,082		
	SUBTOTAL					$2,134,202	
PH1.1.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		16,226,134	2,433,920		
	Escalation - excluded						
	SUBTOTAL					$2,433,920	
PH1.1.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH 1 MEDICAL OFFICE BUILDING						*$18,660,054*

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
67	*Ph 1.3b & c ABOVE GRADE PARKING w/ POWER PLANT*	259,710	sf gfa	787.00	cars		
68		20,000	sf gfa	279,710	total sf gfa		
69	**PH.3b&c.1 TRADE COSTS**						
70	Foundations						
71	Exterior strip footing	942	lf	200.00	188,400		
72	Interior strip footings	402	lf	80.00	32,160		
73	Column footings	40	ea	3,000.00	120,000		
74	Slab on grade	52,470	sf	5.50	288,585		
75	Elevator pit	2	ea	15,000.00	30,000		
76	Superstructure						
77	New structure - predominantly precast	227,240	sf	23.00	5,226,520		
78	Exterior closure						
79	Allowance for façade treatment	47,100	sf	15.00	706,500		
80	Roofing						
81	New roofing	1	ls	10,000.00	10,000		
82	Interior construction						
83	Partitions	279,710	sf gfa	0.80	223,768		
84	Doors	279,710	sf gfa	0.15	41,957		
85	Specialties and casework	279,710	sf gfa	0.27	75,522		
86	Staircase						
87	New egress staircases, complete	8	flt	12,000.00	96,000		
88	Interior finishes						
89	Floor finishes	279,710	sf gfa	1.25	349,638		
90	Wall finishes	279,710	sf gfa	0.15	41,957		
91	Ceiling finishes	279,710	sf gfa	0.45	125,870		
92	Conveying						
93	New elevator	10	stps	22,000.00	220,000		
94	Plumbing						
95	New plumbing installation, complete	279,710	sf gfa	1.00	279,710		
96	Fire protection - assumed required	279,710	sf gfa	0.65	181,812		
97	HVAC (cost of equipment in building costs)						
98	Power plant	20,000	sf gfa	6.00	120,000		
99	Parking garage	1	ls	7,500.00	7,500		
100	Electrical						
101	Power plant	20,000	sf gfa	6.00	120,000		
102	Parking garage	259,710	sf gfa	3.00	779,130		
103	Furnishings and equipment						
104	allowance	279,710	sf gfa	0.50	139,855		
105	Special construction - "green" design	279,710	sf gfa	1.01	282,507		
106	Building Demolition				No work anticipated		
107	Allow for site preparation and development (immediate vicinity)				See Sitework below		
108	Utility Connections						
109	New sanitary connections	1	ls	10,000.00	10,000		
110	New electrical service	1	ls	15,000.00	15,000		
111	New water service	1	ls	10,000.00	10,000		
112	New storm water	1	ls	12,000.00	12,000		
113	New gas service	1	ls	7,500.00	7,500		
114	SUBTOTAL					$9,741,891	
115							
116	**PH.3b&c.2 MARKUPS**						
117	General Conditions	8.0%		9,741,891	779,351		
118	Insurance & bond	1.50%		10,521,242	157,819		
119	Permit	1.00%		10,679,061	106,791		
120	Overhead & profit/fee	4.00%		10,785,852	431,434		
121	SUBTOTAL					$1,475,395	
122							
123	**PH.3b&c.3 CONTINGENCIES**						
124	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		11,217,286	1,682,593		
125	Escalation - excluded						
126	SUBTOTAL					$1,682,593	
127							

MASTERPLAN COST ESTIMATE

DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
PH.3b&c.4 SOFT COSTS						
Soft costs (fees and other costs)				By others		
Construction Contingency				by others		
SUBTOTAL					By others	
TOTAL - PARKING/POWER ABOVE GRADE						***$12,899,879***
Ph 1.3d PARKING (HOSPITAL EAST SIDE)	148,500	sf gfa	450	spaces		
PH 1.3d.1 TRADE COSTS						
Foundations						
Exterior strip footing	341	lf	200.00	68,200		
Interior strip footings	242	lf	80.00	19,360		
Column footings	20	ea	3,000.00	60,000		
Slab on grade	148,500	sf	5.50	816,750		
Elevator pit	2	ea	15,000.00	30,000		
Superstructure						
New structure - predominantly precast	0	sf	23.00			
Exterior closure						
Allowance for façade treatment	20,454	sf	10.00	204,540		
Roofing						
New roofing	1	ls	10,000.00	10,000		
New plaza waterproofing	24,750	sf	8.00	198,000		
Interior construction						
Partitions	148,500	sf gfa	0.40	59,400		
Doors	148,500	sf gfa	0.08	11,880		
Specialties and casework	148,500	sf gfa	0.18	26,730		
Staircase						
New egress staircases, complete	3	flt	12,000.00	36,000		
Interior finishes						
Floor finishes	148,500	sf gfa	1.25	185,625		
Wall finishes	148,500	sf gfa	0.15	22,275		
Ceiling finishes	148,500	sf gfa	0.45	66,825		
Conveying						
New elevator	2	stps	22,000.00	44,000		
Plumbing						
New plumbing installation, complete	148,500	sf gfa	1.00	148,500		
Fire protection - assumed required	148,500	sf gfa	0.65	96,525		
HVAC (cost of equipment in building costs)						
Parking garage	1	ls	5,000.00	5,000		
Electrical						
Parking garage	148,500	sf gfa	3.00	445,500		
Furnishings and equipment						
allowance	148,500	sf gfa	0.50	74,250		
Special construction						
"Green design"	148,500	sf gfa	0.55	81,675		
Building Demolition				No work anticipated		
Allow for site preparation and development (immediate vicinity)				See Sitework below		
Utility Connections						
New sanitary connections	1	ls	10,000.00	10,000		
New electrical service	1	ls	20,000.00	20,000		
New water service	1	ls	20,000.00	20,000		
New storm water	1	ls	30,000.00	30,000		
New gas service	1	ls	14,000.00	14,000		
SUBTOTAL					$2,805,035	
PH 1.3d.2 MARKUPS						
General Conditions	8.0%		2,805,035	224,403		
Insurance & bond	1.50%		3,029,438	45,442		
Permit	1.00%		3,074,880	30,749		
Overhead & profit/fee	4.00%		3,105,629	124,225		
SUBTOTAL					$424,819	

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
	PH 1.3d.3 CONTINGENCIES						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		3,229,854	484,478		
	Escalation - excluded						
	SUBTOTAL					$484,478	
	PH 1.3d.4 SOFT COSTS						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH1 PARKIMG (HOSPITAL EAST SIDE)						*$3,714,332*
	Ph 1.3e AMBULATORY BUILDING #1	100,000	sf gfa				
	PH1.3e.1 TRADE COSTS						
	Foundations						
	Strip footings	680	lf	200.00	136,000		
	Column footings	40	ea	1,000.00	40,000		
	Slab on grade	20,000	sf	5.50	110,000		
	Elevator pit	2	ea	15,000.00	30,000		
	Superstructure						
	New structure	100,000	sf	23.00	2,300,000		
	Exterior closure						
	New brick exterior façade	33,320	sf	42.00	1,399,440		
	New windows	14,280	sf	65.00	928,200		
	New entrance	500	sf	80.00	40,000		
	Roofing						
	New roofing	20,000	sf	25.00	500,000		
	Interior construction						
	Partitions	100,000	sf gfa	14.00	1,400,000		
	Doors	500	lvls	1,200.00	600,000		
	Specialties and casework	100,000	sf gfa	14.00	1,400,000		
	Staircase						
	New egress staircases, complete	10	flt	17,000.00	170,000		
	Interior finishes						
	Floor finishes	100,000	sf gfa	2.50	250,000		
	Wall finishes	100,000	sf gfa	3.75	375,000		
	Ceiling finishes	100,000	sf gfa	3.50	350,000		
	Conveying						
	New elevator	10	stps	22,000.00	220,000		
	Plumbing						
	New plumbing installation, complete	100,000	sf gfa	20.00	2,000,000		
	Fire protection - assumed required	100,000	sf gfa	4.00	400,000		
	HVAC	100,000	sf gfa	53.00	5,300,000		
	Electrical	100,000	sf gfa	32.00	3,200,000		
	Furnishings and equipment						
	Entrance mats and window treatment	100,000	sf gfa	1.00	100,000		
	Radiation Protection & Screening	1	is	125,000.00	125,000		
	Special construction - "green" design	100,000	sf gfa	6.43	643,000		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See Sitework below		
	Utility Connections						
	New sanitary connections	1	ls	15,000.00	15,000		
	New electrical service	1	ls	15,000.00	15,000		
	New water service	1	ls	10,000.00	10,000		
	New storm water	1	ls	12,000.00	12,000		
	New gas service	1	ls	7,500.00	7,500		
	SUBTOTAL					$22,076,140	

MASTERPLAN COST ESTIMATE

DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
PH1.3e.2 MARKUPS						
General Conditions	8.0%		22,076,140	1,766,091		
Insurance & bond	1.50%		23,842,231	357,633		
Permit	1.00%		24,199,864	241,999		
Overhead & profit/fee	4.00%		24,441,863	977,675		
SUBTOTAL					$3,343,398	
PH1.3e.3 CONTINGENCIES						
Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		25,419,538	3,812,931		
Escalation - excluded						
SUBTOTAL					$3,812,931	
PH1.3e.4 SOFT COSTS						
Soft costs (fees and other costs)				By others		
Construction Contingency				by others		
SUBTOTAL					By others	
TOTAL - PH 1 AMBULATORY BUILDING #1						***$29,232,469***
Ph 1.3e AMBULATORY BUILDING #2	85,000	sf gfa				
PH1.3e.1 TRADE COSTS						
Foundations						
Strip footings	690	lf	200.00	138,000		
Column footings	40	ea	1,000.00	40,000		
Slab on grade	21,250	sf	5.50	116,875		
Elevator pit	2	ea	15,000.00	30,000		
Superstructure						
New structure	85,000	sf	23.00	1,955,000		
Exterior closure						
New brick exterior façade	27,048	sf	42.00	1,136,016		
New windows	11,592	sf	65.00	753,480		
New entrance	500	sf	80.00	40,000		
Roofing						
New roofing	21,250	sf	25.00	531,250		
Interior construction						
Partitions	85,000	sf gfa	14.00	1,190,000		
Doors	425	lvls	1,200.00	510,000		
Specialties and casework	85,000	sf gfa	14.00	1,190,000		
Staircase						
New egress staircases, complete	9	flt	17,000.00	153,000		
Interior finishes						
Floor finishes	85,000	sf gfa	2.50	212,500		
Wall finishes	85,000	sf gfa	3.75	318,750		
Ceiling finishes	85,000	sf gfa	3.50	297,500		
Conveying						
New elevator	8	stps	22,000.00	176,000		
Plumbing						
New plumbing installation, complete	85,000	sf gfa	20.00	1,700,000		
Fire protection - assumed required	85,000	sf gfa	4.00	340,000		
HVAC	85,000	sf gfa	53.00	4,505,000		
Electrical	85,000	sf gfa	32.00	2,720,000		
Furnishings and equipment						
Entrance mats and window treatment	100,000	sf gfa	1.00	100,000		
Radiation Protection & Screening	1	ls	125,000.00	125,000		
Special construction - "green" design	85,000	sf gfa	6.47	549,950		
Building Demolition				No work anticipated		
Allow for site preparation and development (immediate vicinity)				See Sitework below		
Utility Connections						
New sanitary connections	1	ls	15,000.00	15,000		
New electrical service	1	ls	15,000.00	15,000		
New water service	1	ls	10,000.00	10,000		
New storm water	1	ls	12,000.00	12,000		
New gas service	1	ls	7,500.00	7,500		
SUBTOTAL					$18,887,821	

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
PH1.3e.2	**MARKUPS**						
	General Conditions	8.0%		18,887,821	1,511,026		
	Insurance & bond	1.50%		20,398,847	305,983		
	Permit	1.00%		20,704,830	207,048		
	Overhead & profit/fee	4.00%		20,911,878	836,475		
	SUBTOTAL					$2,860,532	
PH1.3e.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		21,748,353	3,262,253		
	Escalation - excluded						
	SUBTOTAL					$3,262,253	
PH1.3e.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH 1 AMBULATORY BUILDING #2						***$25,010,606***
Ph 1.3e	***AMBULATORY BUILDING #3***	22,000	sf gfa				
PH1.3e.1	**TRADE COSTS**						
	Foundations						
	Strip footings	436	lf	200.00	87,200		
	Column footings	21	ea	1,000.00	21,000		
	Slab on grade	11,000	sf	5.50	60,500		
	Elevator pit	2	ea	15,000.00	30,000		
	Superstructure						
	New structure	22,000	sf	23.00	506,000		
	Exterior closure						
	New brick exterior façade	8,546	sf	42.00	358,932		
	New windows	3,663	sf	65.00	238,095		
	New entrance	500	sf	80.00	40,000		
	Roofing						
	New roofing	11,000	sf	25.00	275,000		
	Interior construction						
	Partitions	22,000	sf gfa	14.00	308,000		
	Doors	73	lvls	1,200.00	87,600		
	Specialties and casework	22,000	sf gfa	14.00	308,000		
	Staircase						
	New egress staircases, complete	4	flt	17,000.00	68,000		
	Interior finishes						
	Floor finishes	22,000	sf gfa	2.50	55,000		
	Wall finishes	22,000	sf gfa	3.75	82,500		
	Ceiling finishes	22,000	sf gfa	3.50	77,000		
	Conveying						
	New elevator	4	stps	22,000.00	88,000		
	Plumbing						
	New plumbing installation, complete	22,000	sf gfa	20.00	440,000		
	Fire protection - assumed required	22,000	sf gfa	4.00	88,000		
	HVAC	22,000	sf gfa	53.00	1,166,000		
	Electrical	22,000	sf gfa	32.00	704,000		
	Furnishings and equipment						
	Entrance mats and window treatment	100,000	sf gfa	1.00	100,000		
	Radiation Protection & Screening	1	ls	50,000.00	50,000		
	Special construction - "green" design	22,000	sf gfa	7.22	158,840		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See Sitework below		

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
	Utility Connections						
	New sanitary connections	1	ls	15,000.00	15,000		
	New electrical service	1	ls	15,000.00	15,000		
	New water service	1	ls	10,000.00	10,000		
	New storm water	1	ls	12,000.00	12,000		
	New gas service	1	ls	7,500.00	7,500		
	SUBTOTAL					$5,457,167	
PH1.3e.2	**MARKUPS**						
	General Conditions	8.0%		5,457,167	436,573		
	Insurance & bond	1.50%		5,893,740	88,406		
	Permit	1.00%		5,982,146	59,821		
	Overhead & profit/fee	4.00%		6,041,967	241,679		
	SUBTOTAL					$826,479	
PH1.3e.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		6,283,646	942,547		
	Escalation - excluded						
	SUBTOTAL					$942,547	
PH1.3e.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH 1 AMBULATORY BUILDING #3						***$7,226,193***
Ph 1.3g	***BED TOWER #1***	135,000	sf gfa				
PH1.3g.1	**TRADE COSTS**						
	Foundations						
	Strip footings	782	lf	200.00	156,400		
	Column footings	48	ea	1,000.00	48,000		
	Slab on grade	22,500	sf	5.50	123,750		
	Elevator pit	3	ea	15,000.00	45,000		
	Superstructure						
	New structure	135,000	sf	23.00	3,105,000		
	Exterior closure						
	New brick exterior façade	45,982	sf	42.00	1,931,244		
	New windows	19,706	sf	65.00	1,280,890		
	New entrance	250	sf	80.00	20,000		
	Roofing						
	New roofing	22,500	sf	25.00	562,500		
	Interior construction						
	Partitions	135,000	sf gfa	12.00	1,620,000		
	Doors	338	lvls	1,200.00	405,600		
	Specialties and casework	135,000	sf gfa	4.50	607,500		
	Staircase						
	New egress staircases, complete	10	flt	17,000.00	170,000		
	Interior finishes						
	Floor finishes	135,000	sf gfa	5.50	742,500		
	Wall finishes	135,000	sf gfa	5.00	675,000		
	Ceiling finishes	135,000	sf gfa	3.75	506,250		
	Conveying						
	New elevator	18	stps	22,000.00	396,000		
	Plumbing						
	New plumbing installation, complete	135,000	sf gfa	15.00	2,025,000		
	Fire protection - assumed required	135,000	sf gfa	3.50	472,500		
	HVAC	135,000	sf gfa	35.00	4,725,000		
	Electrical	135,000	sf gfa	22.00	2,970,000		
	Furnishings and equipment						
	Entrance mats and window treatment	135,000	sf gfa	1.00	135,000		
	Special construction						
	"Green" design	135,000	sf gfa	5.06	683,100		
	Allow for site preparation and development (immediate vicinity)				See Sitework below		

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
	Utility Connections						
	New sanitary connections	1	ls	20,000.00	20,000		
	New electrical service	1	ls	15,000.00	15,000		
	New water service	1	ls	10,000.00	10,000		
	New storm water	1	ls	15,000.00	15,000		
	New gas service	1	ls	7,500.00	7,500		
	SUBTOTAL					$23,473,734	
PH1.3g.2	**MARKUPS**						
	General Conditions	8.0%		23,473,734	1,877,899		
	Insurance & bond	1.50%		25,351,633	380,274		
	Permit	1.00%		25,731,907	257,319		
	Overhead & profit/fee	4.00%		25,989,226	1,039,569		
	SUBTOTAL					$3,555,061	
PH1.3g.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		27,028,795	4,054,319		
	Escalation - excluded						
	SUBTOTAL					$4,054,319	
PH1.3g.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH 1 BED TOWER #1						***$31,083,114***
Ph 1.3g	***HOSPITAL SUPPORT***	127,000	sf gfa				
PH1.3g.1	**TRADE COSTS**						
	Foundations						
	Strip footings	840	lf	200.00	168,000		
	Column footings	65	ea	1,000.00	65,000		
	Slab on grade	42,333	sf	5.50	232,832		
	Elevator pit	4	ea	15,000.00	60,000		
	Superstructure						
	New structure	127,000	sf	23.00	2,921,000		
	Exterior closure						
	New brick exterior façade	24,696	sf	42.00	1,037,232		
	New windows	10,584	sf	65.00	687,960		
	New entrance	1,000	sf	80.00	80,000		
	Roofing						
	New roofing	42,333	sf	25.00	1,058,325		
	Interior construction						
	Partitions	127,000	sf gfa	14.00	1,778,000		
	Doors	635	lvls	1,200.00	762,000		
	Specialties and casework	127,000	sf gfa	12.00	1,524,000		
	Staircase						
	New egress staircases, complete	8	flt	17,000.00	136,000		
	Interior finishes						
	Floor finishes	127,000	sf gfa	2.50	317,500		
	Wall finishes	127,000	sf gfa	3.75	476,250		
	Ceiling finishes	127,000	sf gfa	3.50	444,500		
	Conveying						
	New elevator	12	stps	22,000.00	264,000		
	Plumbing						
	New plumbing installation, complete	127,000	sf gfa	15.00	1,905,000		
	Fire protection - assumed required	127,000	sf gfa	3.50	444,500		
	HVAC	127,000	sf gfa	45.00	5,715,000		
	Electrical	127,000	sf gfa	28.00	3,556,000		
	Furnishings and equipment						
	Entrance mats and window treatment	127,000	sf gfa	1.00	127,000		
	Special construction						
	"Green" design	127,000	sf gfa	5.64	716,280		

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See Sitework below		
	Utility Connections						
	New sanitary connections	1	ls	40,000.00	40,000		
	New electrical service	1	ls	30,000.00	30,000		
	New water service	1	ls	20,000.00	20,000		
	New storm water	1	ls	30,000.00	30,000		
	New gas service	1	ls	15,000.00	15,000		
	SUBTOTAL					$24,611,379	
PH1.3g.2	**MARKUPS**						
	General Conditions	8.0%		24,611,379	1,968,910		
	Insurance & bond	1.50%		26,580,289	398,704		
	Permit	1.00%		26,978,993	269,790		
	Overhead & profit/fee	4.00%		27,248,783	1,089,951		
	SUBTOTAL					$3,727,355	
PH1.3g.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		28,338,734	4,250,810		
	Escalation - excluded						
	SUBTOTAL					$4,250,810	
PH1.3g.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH 1 HOSPITAL SUPPORT						*$32,589,544*
Ph 1.4a	*WORK TO EXISTING PARKING STRUCTURE*	360,000	sf gfa	1,200	spaces		
PH 1.4a.1	**TRADE COSTS**						
	Allowance for minimal miscellaneous modifications to existing structure	360,000	sf	5.00	1,800,000		
	SUBTOTAL					$1,800,000	
PH 1.4a.1	**MARKUPS**						
	General Conditions	8.0%		1,800,000	144,000		
	Insurance & bond	1.50%		1,944,000	29,160		
	Permit	1.00%		1,973,160	19,732		
	Overhead & profit/fee	4.00%		1,992,892	79,716		
	SUBTOTAL					$272,608	
PH 1.4a.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		2,072,608	310,891		
	Escalation - excluded						
	SUBTOTAL					$310,891	
PH 1.4a.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH 1 EXISTING PARKING STRUCTURE						*$2,383,499*

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
	Ph 1.4b RESEARCH & ACADEMIC BUILDING #1	100,000	sf gfa				
PH 1.4b.1	**TRADE COSTS**						
	Foundations						
	Strip footings	759	lf	200.00	151,800		
	Column footings	27	ea	1,000.00	27,000		
	Slab on grade	20,000	sf	5.50	110,000		
	Elevator pit	2	ea	15,000.00	30,000		
	Superstructure						
	New structure	100,000	sf	23.00	2,300,000		
	Exterior closure						
	New brick exterior façade	32,340	sf	42.00	1,358,280		
	New windows	13,860	sf	65.00	900,900		
	New entrance	250	sf	80.00	20,000		
	Roofing						
	New roofing	20,000	sf	25.00	500,000		
	Interior construction						
	Partitions	100,000	sf gfa	18.00	1,800,000		
	Doors	333	lvls	1,200.00	399,600		
	Specialties and casework	100,000	sf gfa	5.00	500,000		
	Staircase						
	New egress staircases, complete	9	flt	17,000.00	153,000		
	Interior finishes						
	Floor finishes	100,000	sf gfa	5.00	500,000		
	Wall finishes	100,000	sf gfa	3.50	350,000		
	Ceiling finishes	100,000	sf gfa	4.00	400,000		
	Conveying						
	New elevator	10	stps	22,000.00	220,000		
	Plumbing						
	New plumbing installation, complete	100,000	sf gfa	12.00	1,200,000		
	Fire protection - assumed required	100,000	sf gfa	3.50	350,000		
	HVAC	100,000	sf gfa	60.00	6,000,000		
	Electrical	100,000	sf gfa	28.00	2,800,000		
	Furnishings and equipment						
	Entrance mats and window treatment	100,000	sf gfa	0.35	35,000		
	Laboratory casework	100,000	sf gfa	7.50	750,000		
	Special construction - "green" design	100,000	sf gfa	6.27	627,000		
	Building Demolition - Demolish existing East Section of West Garage	1	ls	100,000.00	100,000		
	Allow for site preparation and development (immediate vicinity)				See Sitework below		
	Utility Connections						
	New sanitary connections	1	ls	15,000.00	15,000		
	New electrical service	1	ls	15,000.00	15,000		
	New water service	1	ls	10,000.00	10,000		
	New storm water	1	ls	12,000.00	12,000		
	New gas service	1	ls	7,500.00	7,500		
	SUBTOTAL					$21,642,080	
PH 1.4b.2	**MARKUPS**						
	General Conditions	8.0%		21,642,080	1,731,366		
	Insurance & bond	1.50%		23,373,446	350,602		
	Permit	1.00%		23,724,048	237,240		
	Overhead & profit/fee	4.00%		23,961,288	958,452		
	SUBTOTAL					$3,277,660	
PH 1.4b.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		24,919,740	3,737,961		
	Escalation - excluded						
	SUBTOTAL					$3,737,961	

MASTERPLAN COST ESTIMATE

DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
PH 1.4b.4 SOFT COSTS						
Soft costs (fees and other costs)				By others		
Construction Contingency				by others		
SUBTOTAL					By others	
TOTAL - PH1 RESEARCH & ACADEMIC BLDG						***$28,657,701***
Ph 1.4b RESEARCH & ACADEMIC BUILDING #2	78,000	sf gfa				
PH 1.4b.1 TRADE COSTS						
Foundations						
Strip footings	470	lf	200.00	94,000		
Column footings	24	ea	1,000.00	24,000		
Slab on grade	13,000	sf	5.50	71,500		
Elevator pit	2	ea	15,000.00	30,000		
Superstructure						
New structure	78,000	sf	23.00	1,794,000		
Exterior closure						
New brick exterior façade	27,636	sf	42.00	1,160,712		
New windows	11,844	sf	65.00	769,860		
New entrance	250	sf	80.00	20,000		
Roofing						
New roofing	13,000	sf	25.00	325,000		
Interior construction						
Partitions	78,000	sf gfa	18.00	1,404,000		
Doors	260	lvls	1,200.00	312,000		
Specialties and casework	78,000	sf gfa	5.00	390,000		
Staircase						
New egress staircases, complete	11	flt	17,000.00	187,000		
Interior finishes						
Floor finishes	78,000	sf gfa	5.00	390,000		
Wall finishes	78,000	sf gfa	3.50	273,000		
Ceiling finishes	78,000	sf gfa	4.00	312,000		
Conveying						
New elevator	12	stps	22,000.00	264,000		
Plumbing						
New plumbing installation, complete	78,000	sf gfa	12.00	936,000		
Fire protection - assumed required	78,000	sf gfa	3.50	273,000		
HVAC	78,000	sf gfa	60.00	4,680,000		
Electrical	78,000	sf gfa	28.00	2,184,000		
Furnishings and equipment						
Entrance mats and window treatment	78,000	sf gfa	0.35	27,300		
Laboratory casework	78,000	sf gfa	7.50	585,000		
Special construction - "green" design	78,000	sf gfa	6.37	496,860		
Building Demolition				No work anticipated		
Allow for site preparation and development (immediate vicinity)				See Sitework below		
Utility Connections						
New sanitary connections	1	ls	15,000.00	15,000		
New electrical service	1	ls	15,000.00	15,000		
New water service	1	ls	10,000.00	10,000		
New storm water	1	ls	12,000.00	12,000		
New gas service	1	ls	7,500.00	7,500		
SUBTOTAL					$17,062,732	
PH 1.4b.2 MARKUPS						
General Conditions	8.0%		17,062,732	1,365,019		
Insurance & bond	1.50%		18,427,751	276,416		
Permit	1.00%		18,704,167	187,042		
Overhead & profit/fee	4.00%		18,891,209	755,648		
SUBTOTAL					$2,584,125	

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
PH 1.4b.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		19,646,857	2,947,029		
	Escalation - excluded						
	SUBTOTAL					$2,947,029	
PH 1.4b.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH1 RESEARCH & ACADEMIC BLDG #2						*$22,593,886*
Ph 1.4b	*RESEARCH & ACADEMIC BUILDING #3*	18,000	sf gfa				
PH 1.4b.1	**TRADE COSTS**						
	Foundations						
	Strip footings	380	lf	200.00	76,000		
	Column footings	12	ea	1,000.00	12,000		
	Slab on grade	9,000	sf	5.50	49,500		
	Elevator pit	2	ea	15,000.00	30,000		
	Superstructure						
	New structure	18,000	sf	23.00	414,000		
	Exterior closure						
	New brick exterior façade	7,448	sf	42.00	312,816		
	New windows	3,192	sf	65.00	207,480		
	New entrance	250	sf	80.00	20,000		
	Roofing						
	New roofing	9,000	sf	25.00	225,000		
	Interior construction						
	Partitions	18,000	sf gfa	18.00	324,000		
	Doors	60	lvls	1,200.00	72,000		
	Specialties and casework	18,000	sf gfa	5.00	90,000		
	Staircase						
	New egress staircases, complete	3	flt	17,000.00	51,000		
	Interior finishes						
	Floor finishes	18,000	sf gfa	5.00	90,000		
	Wall finishes	18,000	sf gfa	3.50	63,000		
	Ceiling finishes	18,000	sf gfa	4.00	72,000		
	Conveying						
	New elevator	4	stps	22,000.00	88,000		
	Plumbing						
	New plumbing installation, complete	18,000	sf gfa	12.00	216,000		
	Fire protection - assumed required	18,000	sf gfa	3.50	63,000		
	HVAC	18,000	sf gfa	60.00	1,080,000		
	Electrical	18,000	sf gfa	28.00	504,000		
	Furnishings and equipment						
	Entrance mats and window treatment	18,000	sf gfa	0.35	6,300		
	Laboratory casework	18,000	sf gfa	7.50	135,000		
	Special construction - "green" design	18,000	sf gfa	7.10	127,800		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See Sitework below		
	Utility Connections						
	New sanitary connections	1	ls	15,000.00	15,000		
	New electrical service	1	ls	15,000.00	15,000		
	New water service	1	ls	10,000.00	10,000		
	New storm water	1	ls	12,000.00	12,000		
	New gas service	1	ls	7,500.00	7,500		
	SUBTOTAL					$4,388,396	

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
PH 1.4b.2	**MARKUPS**						
	General Conditions	8.0%		4,388,396	351,072		
	Insurance & bond	1.50%		4,739,468	71,092		
	Permit	1.00%		4,810,560	48,106		
	Overhead & profit/fee	4.00%		4,858,666	194,347		
	SUBTOTAL					$664,617	
PH 1.4b.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		5,053,013	757,952		
	Escalation - excluded						
	SUBTOTAL					$757,952	
PH 1.4b.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH1 RESEARCH & ACADEMIC BLDG						*$5,810,965*
PH1.5	*SITE PREPARATION/DEVELOPMENT*						
PH1.5.1	**TRADE COSTS**						
	Site preparation						
	Site Clearing						
	Allowance for site clearance	46	acre	5,000.00	230,000		
	Site Demolitions and Relocations						
	Site construction fence/barricades	6,300	lf	8.00	50,400		
	Allowance for pavement removal	120,000	sf	0.75	90,000		
	Allowance for demolition of miscellaneous site components	1	ls	20,000.00	20,000		
	Allowance for demolition of existing Benedict building	1	ls	200,000.00	200,000		
	Allowance for demolition of existing Army Reserve Pro	1	ls	100,000.00	100,000		
	Site Earthwork						
	Strip topsoil, store	17,548	cy	4.50	78,966		
	Site cut to fill	37,319	cy	4.25	158,606		
	Rock excavation premium				excluded		
	Fine grading	111,958	sy	0.50	55,979		
	Silt fence/erosion control	3,000	lf	10.00	30,000		
	Allowance for site de-watering	1	ls	40,000.00	40,000		
	Remove contaminated soils				excluded		
	Dispose/treat contaminated water				excluded		
	Site Development						
	Roadways and Parking Lots						
	Bituminous concrete paving	339,508	sf	3.00	1,018,524		
	Vertical granite curb	4,680	lf	32.00	149,760		
	Allowance for new pavement markings	1	ls	33,950.80	33,951		
	Pedestrian paving						
	Concrete paving, 4" thick	271,083	sf	5.70	1,545,173		
	Decorative paving	30,000	sf	20.00	600,000		
	Site Development						
	Promenade						
	Footings	44	ea	750.00	33,000		
	Structure	24,640	sf	30.00	739,200		
	Other hard landscaping features, walls, site furnishings	2,015,235	sf	0.50	1,007,618		
	Soft landscaping (tress, shrubs and plantings)	2,015,235	sf	0.35	705,332		
	Mechanical Utilities						
	Water supply						
	Domestic water & fire protection service	3,500	lf	100.00	350,000		
	Storm Sewer						
	Allow for drainage	2,000	lf	100.00	200,000		
	Heating distribution						
	Steam distribution	3,500	lf	800.00	2,800,000		
	Cooling Distribution						
	Chilled water distribution	3,500	lf	800.00	2,800,000		
	Fuel Distribution						
	Allowance for gas connection	3,500	lf	70.00	245,000		

MASTERPLAN COST ESTIMATE

		DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
		Electrical Utilities						
		Electrical distribution						
		Primary service 4 conduits, 2 active	2,750	lf	100.00	275,000		
		Emergency power distribution	2,750	lf	60.00	165,000		
		Site lighting						
		Car park lighting	94	ea	3,300.00	310,200		
		Walkway lighting	211	ea	3,200.00	675,200		
		Site communications and security						
		Low tension service duct bank - allow 10 conduit	2,750	lf	110.00	302,500		
		Off Site Work						
		New traffic signals at Lake Street	1	ls	200,000.00	200,000		
		SUBTOTAL					$15,209,409	
	PH1.5.2	**MARKUPS**						
		General Conditions	8.0%		15,209,409	1,216,753		
		Insurance & bond	1.50%		16,426,162	246,392		
		Permit	1.00%		16,672,554	166,726		
		Overhead & profit/fee	4.00%		16,839,280	673,571		
		SUBTOTAL					$2,303,442	
	PH1.5.3	**CONTINGENCIES**						
		Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		17,512,851	2,626,928		
		Escalation - excluded						
		SUBTOTAL					$2,626,928	
	PH1.5.4	**SOFT COSTS**						
		Soft costs (fees and other costs)				By others		
		Construction Contingency				by others		
		SUBTOTAL					By others	
		TOTAL - PH1 SITE PREP/DEVELOPMENT						*$20,139,779*

MASTERPLAN COST ESTIMATE

DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
PHASE TWO						
PH 2.5a BED TOWERS (OVER EXTG BLDG)	135,000	sf gfa				
Ph2.5a.1 TRADE COSTS						
Foundations						
Strip footings	782	lf	200.00	No work anticipated		
Column footings within existing building	48	ea	2,000.00	96,000		
Patching slab on grade within existing building	48	loc	1,000.00	48,000		
Elevator pit within existing building	3	ea	22,000.00	66,000		
Superstructure						
New structure	135,000	sf	23.00	3,105,000		
Allow for reinforcing existing roof structure to accommodate floor loading, including the addition of concrete topping	22,500	sf	8.00	180,000		
Exterior closure						
New brick exterior façade	45,982	sf	42.00	1,931,244		
New windows	19,706	sf	65.00	1,280,890		
New entrance	250	sf	80.00	20,000		
Roofing						
New roofing	22,500	sf	25.00	562,500		
Interior construction						
Partitions	135,000	sf gfa	12.00	1,620,000		
Doors	338	lvls	1,200.00	405,600		
Specialties and casework	135,000	sf gfa	4.50	607,500		
Allowance for interior construction at lower levels to accommodate new structural penetrations	1	ls	500,000.00	500,000		
Staircase						
New egress staircases, complete	14	flt	17,000.00	238,000		
Interior finishes						
Floor finishes	135,000	sf gfa	5.50	742,500		
Wall finishes	135,000	sf gfa	5.00	675,000		
Ceiling finishes	135,000	sf gfa	3.75	506,250		
Conveying						
New elevator	20	stps	22,000.00	440,000		
Plumbing						
New plumbing installation, complete	135,000	sf gfa	15.00	2,025,000		
Fire protection - assumed required	135,000	sf gfa	3.50	472,500		
HVAC	135,000	sf gfa	35.00	4,725,000		
Electrical	135,000	sf gfa	22.00	2,970,000		
Furnishings and equipment						
Entrance mats and window treatment	135,000	sf gfa	1.00	135,000		
Special construction						
"Green" design	135,000	sf gfa	5.25	708,750		
Building Demolition	1	ls	200,000.00	200,000		
Allow for site preparation and development (immediate vicinity)				See PH2.9		
Utility Connections						
New sanitary connections	1	ls	20,000.00	20,000		
New electrical service	1	ls	15,000.00	15,000		
New water service	1	ls	10,000.00	10,000		
New storm water	1	ls	15,000.00	15,000		
New gas service	1	ls	7,500.00	7,500		
SUBTOTAL					$24,328,234	
Ph2.5a.2 MARKUPS						
General Conditions	8.0%		24,328,234	1,946,259		
Insurance & bond	1.50%		26,274,493	394,117		
Permit	1.00%		26,668,610	266,686		
Overhead & profit/fee	4.00%		26,935,296	1,077,412		
SUBTOTAL					$3,684,474	

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
Ph2.5a.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		28,012,708	4,201,906		
	Escalation - excluded						
	SUBTOTAL					$4,201,906	
Ph2.5a.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH 2 BED TOWERS						***$32,214,614***
PH 2.5c	***PARKING (HOSPITAL EAST SIDE)***	660,000	sf gfa	2,000	cars		
Ph 2.5c.1	**TRADE COSTS**						
	Foundations						
	Exterior strip footing	1,515	lf	200.00	303,000		
	Interior strip footings	1,074	lf	80.00	85,920		
	Column footings	90	ea	3,000.00	270,000		
	Slab on grade - Included in Phase 1	0	sf	5.50			
	Elevator pit - Included in Phase 1	2	ea	15,000.00	30,000		
	Superstructure						
	New structure - predominantly precast	660,000	sf	23.00	15,180,000		
	Exterior closure						
	Allowance for façade treatment	90,906	sf	10.00	909,060		
	Roofing						
	New roofing	2	ls	10,000.00	20,000		
	New plaza waterproofing	101,063	sf	8.00	808,504		
	Interior construction						
	Partitions	660,000	sf gfa	0.40	264,000		
	Doors	660,000	sf gfa	0.08	52,800		
	Specialties and casework	660,000	sf gfa	0.18	118,800		
	Staircase						
	New egress staircases, complete	15	flt	12,000.00	180,000		
	Interior finishes						
	Floor finishes	660,000	sf gfa	1.25	825,000		
	Wall finishes	660,000	sf gfa	0.15	99,000		
	Ceiling finishes	660,000	sf gfa	0.45	297,000		
	Conveying						
	New elevator	10	stps	22,000.00	220,000		
	Plumbing						
	New plumbing installation, complete	660,000	sf gfa	1.00	660,000		
	Fire protection - assumed required	660,000	sf gfa	0.65	429,000		
	HVAC (cost of equipment in building costs)						
	Parking garage	1	ls	15,000.00	15,000		
	Electrical						
	Parking garage	660,000	sf gfa	3.00	1,980,000		
	Furnishings and equipment						
	allowance	660,000	sf gfa	0.50	330,000		
	Special construction						
	"Green design"	660,000	sf gfa	1.05	693,000		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See PH1.11		
	Utility Connections						
	New sanitary connections	1	ls	10,000.00	10,000		
	New electrical service	1	ls	20,000.00	20,000		
	New water service	1	ls	20,000.00	20,000		
	New storm water	1	ls	30,000.00	30,000		
	New gas service	1	ls	14,000.00	14,000		
	SUBTOTAL					$23,864,084	

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
Ph 2.5c.2	**MARKUPS**						
	General Conditions	8.0%		23,864,084	1,909,127		
	Insurance & bond	1.50%		25,773,211	386,598		
	Permit	1.00%		26,159,809	261,598		
	Overhead & profit/fee	4.00%		26,421,407	1,056,856		
	SUBTOTAL					$3,614,179	
Ph 2.5c.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		27,478,263	4,121,739		
	Escalation - excluded						
	SUBTOTAL					$4,121,739	
Ph 2.5d.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH1 PARKIMG (HOSPITAL EAST SIDE)						***$31,600,002***

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
983							
984	*PH 2.6a PARKING BELOW PLAZA*	429,000	sf	1,144	cars		
985							
986	**Ph2.6a.1 TRADE COSTS**						
987	Foundations						
988	Strip footing	1,551	lf	80.00	124,080		
989	Interior strip footings	60.00	lf	80.00	4,800		
990	Column footings	240	ea	3,000.00	720,000		
991	Slab on grade	95,334	sf	5.50	524,337		
992	Elevator pit	4	ea	15,000.00	60,000		
993	Basement Construction						
994	Basement excavation/backfill	160,655	cy	20.00	3,213,100		
995	Earthwork support	93,060	sf	30.00	2,791,800		
996	Basement walls	82,841	sf	34.00	2,816,594		
997	Superstructure						
998	New structure including plaza construction	429,000	sf	30.00	12,870,000		
999	Exterior closure						
1000	Allowance for head houses	2	ea	50,000.00	100,000		
1001	Roofing						
1002	New plaza waterproofing	95,334	sf	8.00	762,672		
1003	Interior construction						
1004	Partitions	429,000	sf gfa	0.80	343,200		
1005	Doors	429,000	sf gfa	0.15	64,350		
1006	Specialties and casework	429,000	sf gfa	0.27	115,830		
1007	Staircase						
1008	New egress staircases, complete	10	flt	12,000.00	120,000		
1009	Interior finishes						
1010	Floor finishes	429,000	sf gfa	1.25	536,250		
1011	Wall finishes	429,000	sf gfa	0.15	64,350		
012	Ceiling finishes	429,000	sf gfa	0.45	193,050		
1013	Conveying						
1014	New elevator	12	stps	22,000.00	264,000		
1015	Plumbing						
1016	New plumbing installation, complete	429,000	sf gfa	1.00	429,000		
1017	Fire protection - assumed required	429,000	sf gfa	3.00	1,287,000		
1018	HVAC (cost of equipment in building costs)						
1019	Parking garage	429,000	sf gfa	5.50	2,359,500		
1020	Electrical						
1021	Parking garage	429,000	sf gfa	3.50	1,501,500		
1022	Furnishings and equipment						
1023	allowance	429,000	sf gfa	0.40	171,600		
1024	Special construction - "green" design	429,000	sf gfa	2.20	943,800		
1025	Building Demolition				No work anticipated		
1026	Allow for site preparation and development (immediate vicinity)				See PH1.11		
1027	Utility Connections						
1028	New sanitary connections	1	ls	5,000.00	5,000		
1029	New electrical service	1	ls	15,000.00	15,000		
1030	New water service	1	ls	10,000.00	10,000		
1031	New storm water	1	ls	12,000.00	12,000		
1032	New gas service	1	ls	7,500.00	7,500		
1033	SUBTOTAL					$32,430,313	
1034							
1035	**Ph2.6a.2 MARKUPS**						
1036	General Conditions	8.0%		32,430,313	2,594,425		
1037	Insurance & bond	1.50%		35,024,738	525,371		
1038	Permit	1.00%		35,550,109	355,501		
1039	Overhead & profit/fee	4.00%		35,905,610	1,436,224		
1040	SUBTOTAL					$4,911,521	
1041							

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
Ph2.6a.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		37,341,834	5,601,275		
	Escalation - excluded						
	SUBTOTAL					$5,601,275	
Ph2.6a.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH1 UNDERGROUND PARKING						***$42,943,109***
PH2.6a	***PARKING AT SOUTHEAST QUANDRANT***	262,350	sf gfa	795	cars		
PH2.1.1	**TRADE COSTS**						
	Foundations						
	Exterior strip footing	1,386	lf	200.00	277,200		
	Interior strip footings	542	lf	80.00	43,360		
	Column footings	57	ea	3,000.00	171,000		
	Slab on grade	52,470	sf	5.50	288,585		
	Elevator pit	2	ea	15,000.00	30,000		
	Superstructure						
	New structure - predominantly precast	209,880	sf	23.00	4,827,240		
	Exterior closure						
	Allowance for façade treatment	60,040	sf	10.00	600,400		
	Roofing						
	New roofing	2	ls	10,000.00	20,000		
	Interior construction						
	Partitions	262,350	sf gfa	0.40	104,940		
	Doors	262,350	sf gfa	0.08	20,988		
	Specialties and casework	262,350	sf gfa	0.18	47,223		
	Staircase						
	New egress staircases, complete	11	flt	12,000.00	132,000		
	Interior finishes						
	Floor finishes	262,350	sf gfa	1.25	327,938		
	Wall finishes	262,350	sf gfa	0.15	39,353		
	Ceiling finishes	262,350	sf gfa	0.45	118,058		
	Conveying						
	New elevator	10	stps	22,000.00	220,000		
	Plumbing						
	New plumbing installation, complete	262,350	sf gfa	1.00	262,350		
	Fire protection - assumed required	262,350	sf gfa	0.65	170,528		
	HVAC (cost of equipment in building costs)						
	Parking garage	1	ls	15,000.00	15,000		
	Electrical						
	Parking garage	262,350	sf gfa	3.00	787,050		
	Furnishings and equipment						
	allowance	262,350	sf gfa	0.50	131,175		
	Special construction						
	"Green design"	262,350	sf gfa	0.99	259,727		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See PH2.9		
	Utility Connections						
	New sanitary connections	1	ls	7,500.00	7,500		
	New electrical service	1	ls	10,000.00	10,000		
	New water service	1	ls	1,000.00	1,000		
	New storm water	1	ls	15,000.00	15,000		
	New gas service	1	ls	7,000.00	7,000		
	SUBTOTAL					$8,934,615	

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
PH2.1.2	**MARKUPS**						
	General Conditions	8.0%		8,934,615	714,769		
	Insurance & bond	1.50%		9,649,384	144,741		
	Permit	1.00%		9,794,125	97,941		
	Overhead & profit/fee	4.00%		9,892,066	395,683		
	SUBTOTAL					$1,353,134	
PH2.1.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		10,287,749	1,543,162		
	Escalation - excluded						
	SUBTOTAL					$1,543,162	
PH2.1.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH 2 PARKING AT SE QUADRANT						***$11,830,911***
Ph 2.6a	***PARKING BENEATH BLDG - NW QUADRANT***	99,000	sf gfa	300	cars		
Ph2.6a.1	**TRADE COSTS**						
	Foundations						
	Exterior strip footing				In Building Estimate		
	Column footings				In Building Estimate		
	Slab on grade				In Building Estimate		
	Elevator pit				In Building Estimate		
	Superstructure						
	New structure including supported floor construction for building over	99,000	sf	35.00	3,465,000		
	Exterior closure						
	Allowance for façade treatment	23,700	sf	10.00	237,000		
	Roofing						
	No work						
	Interior construction						
	Partitions	99,000	sf gfa	0.50	49,500		
	Doors	99,000	sf gfa	0.10	9,900		
	Specialties and casework	99,000	sf gfa	0.18	17,820		
	Staircase						
	New egress staircases, complete	4	flt	12,000.00	48,000		
	Interior finishes						
	Floor finishes	99,000	sf gfa	1.25	123,750		
	Wall finishes	99,000	sf gfa	0.15	14,850		
	Ceiling finishes	99,000	sf gfa	0.45	44,550		
	Conveying						
	New elevator	6	stps	22,000.00	132,000		
	Plumbing						
	New plumbing installation, complete	99,000	sf gfa	1.00	99,000		
	Fire protection - assumed required	99,000	sf gfa	0.65	64,350		
	HVAC (cost of equipment in building costs)						
	Parking garage	1	ls	5,000.00	5,000		
	Electrical						
	Parking garage	99,000	sf gfa	3.00	297,000		
	Furnishings and equipment allowance	99,000	sf gfa	0.50	49,500		
	Special construction						
	"Green design"	99,000	sf gfa	1.41	139,590		

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See PH2.9		
	Utility Connections						
	New sanitary connections				In Building estimate		
	New electrical service				In Building estimate		
	New water service				In Building estimate		
	New storm water				In Building estimate		
	New gas service				In Building estimate		
	SUBTOTAL					$4,796,810	
Ph2.6a.2	**MARKUPS**						
	General Conditions	8.0%		4,796,810	383,745		
	Insurance & bond	1.50%		5,180,555	77,708		
	Permit	1.00%		5,258,263	52,583		
	Overhead & profit/fee	4.00%		5,310,846	212,434		
	SUBTOTAL					$726,470	
Ph2.6a.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		5,523,280	828,492		
	Escalation - excluded						
	SUBTOTAL					$828,492	
Ph2.6a.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PARKING BENEATH BLDG NW QUADRANT						***$6,351,772***
Ph 2.6b	***RESEARCH BUILDING***	158,500	sf gfa				
Ph2.6b.1	**TRADE COSTS**						
	Foundations						
	Strip footings	1,288	lf	200.00	257,600		
	Column footings	85	ea	1,000.00	85,000		
	Slab on grade	52,883	sf	5.50	290,857		
	Elevator pit	2	ea	15,000.00	30,000		
	Superstructure						
	New structure	158,500	sf	23.00	3,645,500		
	Exterior closure						
	New brick exterior façade	36,221	sf	42.00	1,521,282		
	New windows	15,523	sf	65.00	1,008,995		
	New entrance	250	sf	80.00	20,000		
	Roofing						
	New roofing	52,883	sf	25.00	1,322,075		
	Interior construction						
	Partitions	158,500	sf gfa	18.00	2,853,000		
	Doors	528	lvls	1,200.00	633,600		
	Specialties and casework	158,500	sf gfa	5.00	792,500		
	Staircase						
	New egress staircases, complete	6	flt	17,000.00	102,000		
	Interior finishes						
	Floor finishes	158,500	sf gfa	5.00	792,500		
	Wall finishes	158,500	sf gfa	3.50	554,750		
	Ceiling finishes	158,500	sf gfa	4.00	634,000		
	Conveying						
	New elevator	6	stps	22,000.00	132,000		
	Plumbing						
	New plumbing installation, complete	158,500	sf gfa	12.00	1,902,000		
	Fire protection - assumed required	158,500	sf gfa	3.50	554,750		
	HVAC	158,500	sf gfa	60.00	9,510,000		
	Electrical	158,500	sf gfa	28.00	4,438,000		

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
	Furnishings and equipment						
	Entrance mats and window treatment	158,500	sf gfa	0.35	55,475		
	Laboratory casework	158,500	sf gfa	7.50	1,188,750		
	Special construction - "green" design	158,500	sf gfa	6.13	971,605		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See PH2.9		
	Utility Connections						
	New sanitary connections	1	ls	15,000.00	15,000		
	New electrical service	1	ls	15,000.00	15,000		
	New water service	1	ls	10,000.00	10,000		
	New storm water	1	ls	12,000.00	12,000		
	New gas service	1	ls	7,500.00	7,500		
	SUBTOTAL					$33,355,739	
Ph2.6b.2	**MARKUPS**						
	General Conditions	8.0%		33,355,739	2,668,459		
	Insurance & bond	1.50%		36,024,198	540,363		
	Permit	1.00%		36,564,561	365,646		
	Overhead & profit/fee	4.00%		36,930,207	1,477,208		
	SUBTOTAL					$5,051,676	
Ph2.6b.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		38,407,415	5,761,112		
	Escalation - excluded						
	SUBTOTAL					$5,761,112	
Ph2.6b.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH2 RESEARCH BUILDING						*$44,168,527*
Ph 2.7	*RESEARCH & ACADEMIC BUILDING #1*	100,000	sf gfa				
Ph 2.7.1	**TRADE COSTS**						
	Foundations						
	Strip footings	844	lf	200.00	168,800		
	Column footings	45	ea	1,000.00	45,000		
	Slab on grade	25,000	sf	5.50	137,500		
	Elevator pit	2	ea	15,000.00	30,000		
	Superstructure						
	New structure	100,000	sf	23.00	2,300,000		
	Exterior closure						
	New brick exterior façade	28,773	sf	42.00	1,208,466		
	New windows	12,331	sf	65.00	801,515		
	New entrance	250	sf	80.00	20,000		
	Roofing						
	New roofing	25,000	sf	25.00	625,000		
	Interior construction						
	Partitions	100,000	sf gfa	18.00	1,800,000		
	Doors	333	lvls	1,200.00	399,600		
	Specialties and casework	100,000	sf gfa	5.00	500,000		
	Staircase						
	New egress staircases, complete	9	flt	17,000.00	153,000		
	Interior finishes						
	Floor finishes	100,000	sf gfa	5.00	500,000		
	Wall finishes	100,000	sf gfa	3.50	350,000		
	Ceiling finishes	100,000	sf gfa	4.00	400,000		
	Conveying						
	New elevator	8	stps	22,000.00	176,000		
	Plumbing						
	New plumbing installation, complete	100,000	sf gfa	12.00	1,200,000		
	Fire protection - assumed required	100,000	sf gfa	3.50	350,000		
	HVAC	100,000	sf gfa	60.00	6,000,000		

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
	Electrical	100,000	sf gfa	28.00	2,800,000		
	Furnishings and equipment						
	Entrance mats and window treatment	100,000	sf gfa	0.35	35,000		
	Laboratory casework	100,000	sf gfa	7.50	750,000		
	Special construction - "green" design	100,000	sf gfa	6.24	624,000		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See PH2.9		
	Utility Connections						
	New sanitary connections	1	ls	15,000.00	15,000		
	New electrical service	1	ls	15,000.00	15,000		
	New water service	1	ls	10,000.00	10,000		
	New storm water	1	ls	12,000.00	12,000		
	New gas service	1	ls	7,500.00	7,500		
	SUBTOTAL					$21,433,381	
Ph 2.7.2	**MARKUPS**						
	General Conditions	8.0%		21,433,381	1,714,670		
	Insurance & bond	1.50%		23,148,051	347,221		
	Permit	1.00%		23,495,272	234,953		
	Overhead & profit/fee	4.00%		23,730,225	949,209		
	SUBTOTAL					$3,246,053	
Ph 2.7.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		24,679,434	3,701,915		
	Escalation - excluded						
	SUBTOTAL					$3,701,915	
Ph 2.7.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH1 RESEARCH & ACADEMIC BLDG						***$28,381,349***
PH2.9	***SITE PREPARATION/DEVELOPMENT***						
PH2.9.1	**TRADE COSTS**						
	Site preparation						
	Site Clearing						
	Allowance for site clearance	5	acre	5,000.00	25,000		
	Site Demolitions and Relocations						
	Site construction fence/barricades	3,000	lf	8.00	24,000		
	Allowance for pavement removal	60,000	sf	0.75	45,000		
	Allowance for demolition of miscellaneous site components	1	ls	30,000.00	30,000		
	Allowance for demolition of existing DYS buildings	1	ls	50,000.00	50,000		
	Allowance for demolition of existing State Highway Bui	1	ls	100,000.00	100,000		
	Site Earthwork						
	Strip topsoil, store	1,646	cy	4.50	7,407		
	Site cut to fill	4,404	cy	4.25	18,717		
	Rock excavation premium				excluded		
	Fine grading	13,211	sy	0.50	6,606		
	Silt fence/erosion control	2,500	lf	10.00	25,000		
	Allowance for site de-watering	1	ls	30,000.00	30,000		
	Remove contaminated soils				excluded		
	Dispose/treat contaminated water				excluded		

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
	Site Development						
	Roadways and Parking Lots						
	Bituminous concrete paving	80,376	sf	3.00	241,128		
	Vertical granite curb	3,000	lf	32.00	96,000		
	Allowance for new pavement markings	1	ls	8,037.60	8,038		
	Pedestrian paving						
	Concrete paving, 4" thick	63,332	sf	5.70	360,992		
	Decorative paving	25,000	sf	20.00	500,000		
	Site Development						
	Other hard landscaping features, walls, site furnishings	237,790	sf	0.50	118,895		
	Soft landscaping (tress, shrubs and plantings)	237,790	sf	0.35	83,227		
	Water retention pond, complete	29,735	sf	15.00	446,025		
	Water retention pond, complete	64,151	sf	15.00	962,265		
	Mechanical Utilities						
	Water supply						
	Domestic water & fire protection service	1,500	lf	100.00	150,000		
	Storm Sewer						
	Allow for drainage	1,500	lf	100.00	150,000		
	Heating distribution						
	Steam distribution	1,500	lf	800.00	1,200,000		
	Cooling Distribution						
	Chilled water distribution	1,500	lf	800.00	1,200,000		
	Fuel Distribution						
	Allowance for gas connection	1,500	lf	70.00	105,000		
	Electrical Utilities						
	Electrical distribution						
	Primary service 4 conduits, 2 active	1,750	lf	100.00	175,000		
	Emergency power distribution	1,750	lf	60.00	105,000		
	Site lighting						
	Car park lighting	22	ea	3,300.00	72,600		
	Walkway lighting	94	ea	3,200.00	300,800		
	Site communications and security						
	Low tension service duct bank - allow 10 conduit	1,750	lf	110.00	192,500		
	SUBTOTAL					$6,829,200	
PH2.9.2	**MARKUPS**						
	General Conditions	8.0%		6,829,200	546,336		
	Insurance & bond	1.50%		7,375,536	110,633		
	Permit	1.00%		7,486,169	74,862		
	Overhead & profit/fee	4.00%		7,561,031	302,441		
	SUBTOTAL					$1,034,272	
PH2.9.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		7,863,472	1,179,521		
	Escalation - excluded						
	SUBTOTAL					$1,179,521	
PH2.9.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH2 SITE PREP/DEVELOPMENT						*$9,042,993*

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
	PHASE THREE						
	PH3.1 MEDICAL OFFICE BUILDING	22,000	sf gfa				
	PH3.1.1 TRADE COSTS						
	Foundations						
	Strip footings	434	lf	200.00	86,800		
	Column footings	24	ea	1,000.00	24,000		
	Slab on grade	11,000	sf	5.50	60,500		
	Elevator pit	1	ea	15,000.00	15,000		
	Superstructure						
	New structure	22,000	sf	23.00	506,000		
	Exterior closure						
	New brick exterior façade	7,899	sf	38.00	300,162		
	New windows	187	sf	60.00	11,220		
	New entrance	200	sf	80.00	16,000		
	Roofing						
	New roofing	11,000	sf	20.00	220,000		
	Interior construction						
	Partitions	22,000	sf gfa	10.00	220,000		
	Doors	73	lvls	1,100.00	80,300		
	Specialties and casework	22,000	sf gfa	4.00	88,000		
	Staircase						
	New egress staircases, complete	2	flt	17,000.00	34,000		
	Interior finishes						
	Floor finishes	22,000	sf gfa	3.50	77,000		
	Wall finishes	22,000	sf gfa	2.00	44,000		
	Ceiling finishes	22,000	sf gfa	3.00	66,000		
	Conveying						
	New elevator	2	stps	29,000.00	58,000		
	Plumbing						
	New plumbing installation, complete	22,000	sf gfa	5.00	110,000		
	Fire protection - assumed required	22,000	sf gfa	3.00	66,000		
	HVAC	22,000	sf gfa	30.00	660,000		
	Electrical	22,000	sf gfa	16.00	352,000		
	Furnishings and equipment						
	Entrance mats and window treatment	22,000	sf gfa	0.35	7,700		
	Special construction - "green" design	22,000	sf gfa	4.31	94,820		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See PH3.7		
	Utility Connections						
	New sanitary connections	1	ls	15,000.00	15,000		
	New electrical service	1	ls	15,000.00	15,000		
	New water service	1	ls	10,000.00	10,000		
	New storm water	1	ls	12,000.00	12,000		
	New gas service	1	ls	7,500.00	7,500		
	SUBTOTAL					$3,257,002	
	PH3.1.2 MARKUPS						
	General Conditions	8.0%		3,257,002	260,560		
	Insurance & bond	1.50%		3,517,562	52,763		
	Permit	1.00%		3,570,325	35,703		
	Overhead & profit/fee	4.00%		3,606,028	144,241		
	SUBTOTAL					$493,267	
	PH3.1.3 CONTINGENCIES						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		3,750,269	562,540		
	Escalation - excluded						
	SUBTOTAL					$562,540	
	PH3.1.4 SOFT COSTS						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH 3 MEDICAL OFFICE BUILDING						*$4,312,809*

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
1465							
1466							
1467	*PH 3.2 ACE & PC*	175,000	sf gfa				
1468							
1469	**Ph3.2.1 TRADE COSTS**						
1470	Foundations						
1471	Strip footings	1,260	lf	200.00	252,000		
1472	Column footings	80	ea	1,000.00	80,000		
1473	Slab on grade	43,750	sf	5.50	240,625		
1474	Elevator pit	2	ea	15,000.00	30,000		
1475	Superstructure						
1476	New structure	175,000	sf	23.00	4,025,000		
1477	Exterior closure						
1478	New brick exterior façade	49,392	sf	42.00	2,074,464		
1479	New windows	21,168	sf	65.00	1,375,920		
1480	New entrance	500	sf	80.00	40,000		
1481	Roofing						
1482	New roofing	43,750	sf	25.00	1,093,750		
1483	Interior construction						
1484	Partitions	175,000	sf gfa	14.00	2,450,000		
1485	Doors	875	lvls	1,200.00	1,050,000		
1486	Specialties and casework	175,000	sf gfa	14.00	2,450,000		
1487	Staircase						
1488	New egress staircases, complete	12	flt	17,000.00	204,000		
1489	Interior finishes						
1490	Floor finishes	175,000	sf gfa	2.50	437,500		
1491	Wall finishes	175,000	sf gfa	3.75	656,250		
1492	Ceiling finishes	175,000	sf gfa	3.50	612,500		
1493	Conveying						
1494	New elevator	8	stps	22,000.00	176,000		
1495	Plumbing						
1496	New plumbing installation, complete	175,000	sf gfa	20.00	3,500,000		
1497	Fire protection - assumed required	175,000	sf gfa	4.00	700,000		
1498	HVAC	175,000	sf gfa	53.00	9,275,000		
1499	Electrical	175,000	sf gfa	32.00	5,600,000		
1500	Furnishings and equipment						
1501	Entrance mats and window treatment	175,000	sf gfa	1.00	175,000		
1502	Special construction						
1503	Radiation protections and Shielding	1	bldg	125,000.00	125,000		
1504	"Green" design	175,000	sf gfa	6.29	1,100,750		
1505	Building Demolition				No work anticipated		
1506	Allow for site preparation and development (immediate vicinity)				See PH2.9		
1507	Utility Connections						
1508	New sanitary connections	1	ls	25,000.00	25,000		
1509	New electrical service	1	ls	15,000.00	15,000		
1510	New water service	1	ls	15,000.00	15,000		
1511	New storm water	1	ls	20,000.00	20,000		
1512	New gas service	1	ls	10,000.00	10,000		
1513	SUBTOTAL					$37,808,759	
1514							

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
Ph3.2.2	**MARKUPS**						
	General Conditions	8.0%		37,808,759	3,024,701		
	Insurance & bond	1.50%		40,833,460	612,502		
	Permit	1.00%		41,445,962	414,460		
	Overhead & profit/fee	4.00%		41,860,422	1,674,417		
	SUBTOTAL					$5,726,080	
Ph3.2.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		43,534,839	6,530,226		
	Escalation - excluded						
	SUBTOTAL					$6,530,226	
Ph3.2.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH3 ACE & PC BUILDING						***$50,065,065***
PH3.3	***OFFICE BUILDING #1***	100,000	sf gfa				
PH3.3.1	**TRADE COSTS**						
	Foundations						
	Strip footings	700	lf	200.00	140,000		
	Column footings	36	ea	1,000.00	36,000		
	Slab on grade	25,000	sf	5.50	137,500		
	Elevator pit	2	ea	15,000.00	30,000		
	Superstructure						
	New structure	100,000	sf	23.00	2,300,000		
	Exterior closure						
	New brick exterior façade	27,440	sf	38.00	1,042,720		
	New windows	11,760	sf	60.00	705,600		
	New entrance	500	sf	80.00	40,000		
	Roofing						
	New roofing	25,000	sf	20.00	500,000		
	Interior construction						
	Partitions	100,000	sf gfa	10.00	1,000,000		
	Doors	333	lvls	1,100.00	366,300		
	Specialties and casework	100,000	sf gfa	4.00	400,000		
	Staircase						
	New egress staircases, complete	6	flt	17,000.00	102,000		
	Interior finishes						
	Floor finishes	100,000	sf gfa	3.50	350,000		
	Wall finishes	100,000	sf gfa	2.00	200,000		
	Ceiling finishes	100,000	sf gfa	3.00	300,000		
	Conveying						
	New elevator	8	stps	22,000.00	176,000		
	Plumbing						
	New plumbing installation, complete	100,000	sf gfa	5.00	500,000		
	Fire protection - assumed required	100,000	sf gfa	3.00	300,000		
	HVAC	100,000	sf gfa	30.00	3,000,000		
	Electrical	100,000	sf gfa	16.00	1,600,000		
	Furnishings and equipment						
	Entrance mats and window treatment	100,000	sf gfa	0.35	35,000		
	Special construction - "green" design	100,000	sf gfa	4.01	401,000		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See PH3.7		
	Utility Connections						
	New sanitary connections	1	ls	30,000.00	30,000		
	New electrical service	1	ls	30,000.00	30,000		
	New water service	1	ls	10,000.00	10,000		
	New storm water	1	ls	12,000.00	12,000		
	New gas service	1	ls	7,500.00	7,500		
	SUBTOTAL					$13,751,620	

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
PH3.3.2	**MARKUPS**						
	General Conditions	8.0%		13,751,620	1,100,130		
	Insurance & bond	1.50%		14,851,750	222,776		
	Permit	1.00%		15,074,526	150,745		
	Overhead & profit/fee	4.00%		15,225,271	609,011		
	SUBTOTAL					$2,082,662	
PH3.3.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		15,834,282	2,375,142		
	Escalation - excluded						
	SUBTOTAL					$2,375,142	
PH3.3.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH 3 OFFICE BUILDING #1						*$18,209,424*
PH3.4	*OFFICE BUILDING #2*	100,000	sf gfa				
Ph3.4.1	**TRADE COSTS**						
	Foundations						
	Strip footings	700	lf	200.00	140,000		
	Column footings	36	ea	1,000.00	36,000		
	Slab on grade	25,000	sf	5.50	137,500		
	Elevator pit	2	ea	15,000.00	30,000		
	Superstructure						
	New structure	100,000	sf	23.00	2,300,000		
	Exterior closure						
	New brick exterior façade	27,440	sf	38.00	1,042,720		
	New windows	11,760	sf	60.00	705,600		
	New entrance	500	sf	80.00	40,000		
	Roofing						
	New roofing	25,000	sf	20.00	500,000		
	Interior construction						
	Partitions	100,000	sf gfa	10.00	1,000,000		
	Doors	333	lvls	1,100.00	366,300		
	Specialties and casework	100,000	sf gfa	4.00	400,000		
	Staircase						
	New egress staircases, complete	6	flt	17,000.00	102,000		
	Interior finishes						
	Floor finishes	100,000	sf gfa	3.50	350,000		
	Wall finishes	100,000	sf gfa	2.00	200,000		
	Ceiling finishes	100,000	sf gfa	3.00	300,000		
	Conveying						
	New elevator	8	stps	22,000.00	176,000		
	Plumbing						
	New plumbing installation, complete	100,000	sf gfa	5.00	500,000		
	Fire protection - assumed required	100,000	sf gfa	3.00	300,000		
	HVAC	100,000	sf gfa	30.00	3,000,000		
	Electrical	100,000	sf gfa	16.00	1,600,000		
	Furnishings and equipment						
	Entrance mats and window treatment	100,000	sf gfa	0.35	35,000		
	Special construction - "green" design	100,000	sf gfa	4.01	401,000		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See PH3.7		
	Utility Connections						
	New sanitary connections	1	ls	30,000.00	30,000		
	New electrical service	1	ls	30,000.00	30,000		
	New water service	1	ls	10,000.00	10,000		
	New storm water	1	ls	12,000.00	12,000		
	New gas service	1	ls	7,500.00	7,500		
	SUBTOTAL					$13,751,620	

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
Ph 3.4.2	**MARKUPS**						
	General Conditions	8.0%		13,751,620	1,100,130		
	Insurance & bond	1.50%		14,851,750	222,776		
	Permit	1.00%		15,074,526	150,745		
	Overhead & profit/fee	4.00%		15,225,271	609,011		
	SUBTOTAL					$2,082,662	
Ph3.4.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		15,834,282	2,375,142		
	Escalation - excluded						
	SUBTOTAL					$2,375,142	
Ph3.4.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH 3 OFFICE BUILDING #2						***$18,209,424***
PH3.5	***OFFICE BUILDING #3***	50,000	sf gfa				
PH3.5.1	**TRADE COSTS**						
	Foundations						
	Strip footings	600	lf	200.00	120,000		
	Column footings	24	ea	1,000.00	24,000		
	Slab on grade	16,667	sf	5.50	91,669		
	Elevator pit	2	ea	15,000.00	30,000		
	Superstructure						
	New structure	50,000	sf	23.00	1,150,000		
	Exterior closure						
	New brick exterior façade	17,640	sf	38.00	670,320		
	New windows	7,560	sf	60.00	453,600		
	New entrance	500	sf	80.00	40,000		
	Roofing						
	New roofing	16,667	sf	20.00	333,340		
	Interior construction						
	Partitions	50,000	sf gfa	10.00	500,000		
	Doors	167	lvls	1,100.00	183,700		
	Specialties and casework	50,000	sf gfa	4.00	200,000		
	Staircase						
	New egress staircases, complete	6	flt	17,000.00	102,000		
	Interior finishes						
	Floor finishes	50,000	sf gfa	3.50	175,000		
	Wall finishes	50,000	sf gfa	2.00	100,000		
	Ceiling finishes	50,000	sf gfa	3.00	150,000		
	Conveying						
	New elevator	6	stps	22,000.00	132,000		
	Plumbing						
	New plumbing installation, complete	50,000	sf gfa	5.00	250,000		
	Fire protection - assumed required	50,000	sf gfa	3.00	150,000		
	HVAC	50,000	sf gfa	30.00	1,500,000		
	Electrical	50,000	sf gfa	16.00	800,000		
	Furnishings and equipment						
	Entrance mats and window treatment	50,000	sf gfa	0.35	17,500		
	Special construction - "green" design	50,000	sf gfa	4.34	217,000		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See PH3.7		
	Utility Connections						
	New sanitary connections	1	ls	15,000.00	15,000		
	New electrical service	1	ls	15,000.00	15,000		
	New water service	1	ls	10,000.00	10,000		
	New storm water	1	ls	12,000.00	12,000		
	New gas service	1	ls	7,500.00	7,500		
	SUBTOTAL					$7,449,629	

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
PH3.5.2	**MARKUPS**						
	General Conditions	8.0%		7,449,629	595,970		
	Insurance & bond	1.50%		8,045,599	120,684		
	Permit	1.00%		8,166,283	81,663		
	Overhead & profit/fee	4.00%		8,247,946	329,918		
	SUBTOTAL					$1,128,235	
PH3.5.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		8,577,864	1,286,680		
	Escalation - excluded						
	SUBTOTAL					$1,286,680	
PH3.5.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH 3 OFFICE BUILDING #3						***$9,864,544***

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
	PH 3.6 PARKING ABOVE GRADE	387,750	sf gfa	1,175	car		
PH3.6.1	**TRADE COSTS**						
	Foundations						
	Exterior strip footing	1,222	lf	200.00	244,400		
	Interior strip footings	682	lf	80.00	54,560		
	Column footings	65	ea	3,000.00	195,000		
	Slab on grade	77,550	sf	5.50	426,525		
	Elevator pit	3	ea	15,000.00	45,000		
	Superstructure						
	New structure - predominantly precast	310,200	sf	23.00	7,134,600		
	Exterior closure						
	Allowance for façade treatment	63,600	sf	10.00	636,000		
	Roofing						
	New roofing	3	ls	10,000.00	30,000		
	Interior construction						
	Partitions	387,750	sf gfa	0.50	193,875		
	Doors	387,750	sf gfa	0.10	38,775		
	Specialties and casework	387,750	sf gfa	0.18	69,795		
	Staircase						
	New egress staircases, complete	12	flt	12,000.00	144,000		
	Interior finishes						
	Floor finishes	387,750	sf gfa	1.25	484,688		
	Wall finishes	387,750	sf gfa	0.15	58,163		
	Ceiling finishes	387,750	sf gfa	0.45	174,488		
	Conveying						
	New elevator	15	stps	22,000.00	330,000		
	Plumbing						
	New plumbing installation, complete	387,750	sf gfa	1.00	387,750		
	Fire protection - assumed required	387,750	sf gfa	0.65	252,038		
	HVAC (cost of equipment in building costs)						
	Parking garage	1	ls	15,000.00	15,000		
	Electrical						
	Parking garage	387,750	sf gfa	3.00	1,163,250		
	Furnishings and equipment						
	allowance	387,750	sf gfa	0.50	193,875		
	Special construction						
	"Green design"	387,750	sf gfa	0.48	186,120		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See PH3.7		
	Utility Connections						
	New sanitary connections	1	ls	10,000.00	10,000		
	New electrical service	1	ls	25,000.00	25,000		
	New water service	1	ls	30,000.00	30,000		
	New storm water	1	ls	45,000.00	45,000		
	New gas service	1	ls	21,000.00	21,000		
	SUBTOTAL					$12,588,902	
PH3.6.2	**MARKUPS**						
	General Conditions	8.0%		12,588,902	1,007,112		
	Insurance & bond	1.50%		13,596,014	203,940		
	Permit	1.00%		13,799,954	138,000		
	Overhead & profit/fee	4.00%		13,937,954	557,518		
	SUBTOTAL					$1,906,570	
PH3.6.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		14,495,472	2,174,321		
	Escalation - excluded						
	SUBTOTAL					$2,174,321	

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
PH3.6.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH3 PARKING ABOVE GRADE						***$16,669,793***
PH 3.7	***PARKING ABOVE GRADE***	99,000	sf gfa	300	car		
Ph3.7.1	**TRADE COSTS**						
	Foundations						
	Exterior strip footing	950	lf	200.00	190,000		
	Interior strip footings	520	lf	80.00	41,600		
	Column footings	72	ea	3,000.00	216,000		
	Slab on grade	49,500	sf	5.50	272,250		
	Elevator pit	2	ea	15,000.00	30,000		
	Superstructure						
	New structure - predominantly precast	49,500	sf	23.00	1,138,500		
	Exterior closure						
	Allowance for façade treatment	19,000	sf	10.00	190,000		
	Roofing						
	New roofing	3	ls	10,000.00	30,000		
	Interior construction						
	Partitions	99,000	sf gfa	0.50	49,500		
	Doors	99,000	sf gfa	0.10	9,900		
	Specialties and casework	99,000	sf gfa	0.18	17,820		
	Staircase						
	New egress staircases, complete	4	flt	12,000.00	48,000		
	Interior finishes						
	Floor finishes	99,000	sf gfa	1.25	123,750		
	Wall finishes	99,000	sf gfa	0.15	14,850		
	Ceiling finishes	99,000	sf gfa	0.45	44,550		
	Conveying						
	New elevator	4	stps	22,000.00	88,000		
	Plumbing						
	New plumbing installation, complete	99,000	sf gfa	1.00	99,000		
	Fire protection - assumed required	99,000	sf gfa	0.65	64,350		
	HVAC (cost of equipment in building costs)						
	Parking garage	1	ls	15,000.00	15,000		
	Electrical						
	Parking garage	99,000	sf gfa	3.00	297,000		
	Furnishings and equipment						
	allowance	99,000	sf gfa	0.50	49,500		
	Special construction						
	"Green design"	99,000	sf gfa	0.48	47,520		
	Building Demolition				No work anticipated		
	Allow for site preparation and development (immediate vicinity)				See PH3.7		
	Utility Connections						
	New sanitary connections	1	ls	10,000.00	10,000		
	New electrical service	1	ls	25,000.00	25,000		
	New water service	1	ls	30,000.00	30,000		
	New storm water	1	ls	45,000.00	45,000		
	New gas service	1	ls	21,000.00	21,000		
	SUBTOTAL					$3,208,090	
Ph3.7.2	**MARKUPS**						
	General Conditions	8.0%		3,208,090	256,647		
	Insurance & bond	1.50%		3,464,737	51,971		
	Permit	1.00%		3,516,708	35,167		
	Overhead & profit/fee	4.00%		3,551,875	142,075		
	SUBTOTAL					$485,860	

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
Ph3.7.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		3,693,950	554,093		
	Escalation - excluded						
	SUBTOTAL					$554,093	
Ph3.7.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH3 PARKING ABOVE GRADE						*$4,248,043*
PH3.8	*SITE PREPARATION/DEVELOPMENT*						
Ph3.8.1	**TRADE COSTS**						
	Site preparation						
	Site Clearing						
	Allowance for site clearance	23	acre	5,000.00	115,000		
	Site Demolitions and Relocations						
	Site construction fence/barricades	2,500	lf	8.00	20,000		
	Allowance for pavement removal	40,000	sf	0.75	30,000		
	Allowance for demolition of miscellaneous site components	1	ls	7,500.00	7,500		
	Site Earthwork						
	Strip topsoil, store	8,854	cy	4.50	39,843		
	Site cut to fill	18,449	cy	4.25	78,408		
	Rock excavation premium				excluded		
	Fine grading	55,347	sy	0.50	27,674		
	Silt fence/erosion control	1,500	lf	10.00	15,000		
	Allowance for site de-watering	1	ls	20,000.00	20,000		
	Remove contaminated soils				excluded		
	Dispose/treat contaminated water		ls		excluded		
	Site Development						
	Roadways and Parking Lots						
	Bituminous concrete paving	52,620	sf	3.00	157,860		
	Vertical granite curb	750	lf	32.00	24,000		
	Allowance for new pavement markings	1	ls	5,262.00	5,262		
	Pedestrian paving						
	Concrete paving, 4" thick	204,298	sf	5.70	1,164,499		
	Decorative paving	15,000	sf	20.00	300,000		
	Site Development						
	Other hard landscaping features, walls, site furnishings	996,249	sf	0.50	498,125		
	Soft landscaping (tress, shrubs and plantings)	996,249	sf	0.35	348,687		
	Mechanical Utilities						
	Water supply						
	Domestic water & fire protection service	1,500	lf	100.00	150,000		
	Storm Sewer						
	Allow for drainage	1,200	lf	100.00	120,000		
	Heating distribution						
	Steam distribution	1,500	lf	800.00	1,200,000		
	Cooling Distribution						
	Chilled water distribution	1,500	lf	800.00	1,200,000		
	Fuel Distribution						
	Allowance for gas connection	1,500	lf	70.00	105,000		
	Electrical Utilities						
	Electrical distribution						
	Primary service 4 conduits, 2 active	1,500	lf	100.00	150,000		
	Emergency power distribution	1,500	lf	60.00	90,000		
	Site lighting						
	Car park lighting	15	ea	3,300.00	49,500		
	Walkway lighting	140	ea	3,200.00	448,000		
	Site communications and security						
	Low tension service duct bank - allow 10 conduit	1,500	lf	110.00	165,000		
	SUBTOTAL					$6,529,358	

MASTERPLAN COST ESTIMATE

	DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
Ph3.8.2	**MARKUPS**						
	General Conditions	8.0%		6,529,358	522,349		
	Insurance & bond	1.50%		7,051,707	105,776		
	Permit	1.00%		7,157,483	71,575		
	Overhead & profit/fee	4.00%		7,229,058	289,162		
	SUBTOTAL					$988,862	
Ph3.8.3	**CONTINGENCIES**						
	Design and pricing contingency (reduces to 0% at Construction Documents)	15.00%		7,518,220	1,127,733		
	Escalation - excluded						
	SUBTOTAL					$1,127,733	
Ph3.8.4	**SOFT COSTS**						
	Soft costs (fees and other costs)				By others		
	Construction Contingency				by others		
	SUBTOTAL					By others	
	TOTAL - PH3 SITE PREP/DEVELOPMENT						*$8,645,953*

TSOI / KOBUS & ASSOCIATES
ARCHITECTS

University of Massachusetts Medical School
Appendix

APPENDIX - MEETING NOTES

MEETING NOTES

Mass State Project UMW 0301 ST1/TK&A #23024-00
UMass Medical Center Master Plan
September 21, 2004, Executive Steering Committee Meeting #1

Jack Synnott

Present:
Tom Manning, UMMS
Tim Fitzpatrick, UMMS
Aaron Lazare, MD, UMMS
Cheryl Scheid, UMMS
John Sullivan, MD, UMMS
Bob Jenal, UMMS
Rick Stanton, UMMS
Schuyler Larrabee, DCAM
Ed Tsoi, TK&A
Rick Kobus, TK&A
Jack Synnott, TK&A
David Owens, TK&A

Distribution:
Attendees
Mike Williams, DCAM
Carol Chiles, TK&A
TK&A Team
File 23024-00

UMMS Executive Steering Committee Meeting #1
Ed Tsoi opened the meeting with an update of progress since the last meeting and an acknowledgment that organizing meetings over the summer had been a challenge. Nonetheless, we have finally settled on 4 dates and have prepared a presentation of initial design ideas for this meeting. We would also be discussing the progress on the space program.

1. David Owens began with a summary of the intent of this presentation:
   - Investigate a strong campus identity
   - Develop a clear delineation of territories
   - Modulate scales
   - Develop a Master Plan that establishes "highest and best use"

2. Some of the drivers for this study include parking, service access, program and wayfinding

3. The outline program used for this study includes:
   - 75,000 GSF of Academic
   - 100,000 GSF of Research
   - 120,000 GSF of Medical Office Building
   - 180,000 GSF of Ambulatory
   - 110,000 GSF of Hospital

4. Issues to be resolved in determining campus identity include the "edges" of the space as perceived from the inside and the outside, the entries and, in this case, the central landscaped space.

5. Using these criteria, three design concepts were presented:
   a. A "campus quad" scheme could be developed emphasizing and connecting the entrances from Plantation and Lake. The common green space would become much more a pedestrian space with auto traffic to the hospital reorganized off this east-west connector.
   b. The second option retained the same auto traffic and building entries within the green space as they are now, but enters the space from a new entrance directly off Route 9.
   c. The third option seeks to develop a new image for the campus with a green buffer along Route 9. Entry to the site and circulation are similar to Option1.

6. The "holding capacity" of the site was tested for each scheme. The Powerpoint presentation is attached to this report and contains information on each option. The summary information contained on the presentation boards is also attached.

7. General Discussion
   - There was a question as to whether underground parking had been considered for any of these schemes. The cost of underground parking is considerably greater than surface or above-grade structured parking and is a function of the site conditions, particularly water table and kind of foundation system to be used. It was pointed out by Schuyler Larrabee that the difference in cost between above-grade structured parking and surface parking is largely due to the cost of the land itself. Underground parking will be studied further as site concepts evolve.
   - It was pointed out that a new two-way entry off Route 9 may not be a feasible alternative and further exploration of that constraint should be done.
   - Acquiring property along Route 9 not currently owned by the Medical School should be addressed in a phased approach to site buildout.
   - Rick Kobus noted that the outcome of the study will also depend on a realistic assessment of the rate of capital expenditure over 5 and 10 year cycles.
   - Rick Stanton suggested that TK&A investigate the possibility that an all-new 600-bed hospital would have to be accommodated in the unforeseen future.

Testing that theory would give important feedback to the judgment of the site's carrying capacity.

- A similar suggestion was made for research space. It was speculated that the potential growth in clinical research could add the need for three times the space of the Lazare building. This idea will be tested conceptually on site.
- Cheryl Scheid noted that the idea of a purely pedestrian mall occupying the central green space would be limited by the hospital's future plans. With the main entrance for the medical center shifting to the east as these schemes imply, the central green area will be much less congested without the auto requirements of inpatients, visitors and outpatients.
- Jack Synnott presented a very brief overview of the current program development for the education space, including outstanding issues. Copies of the handouts are attached. The program calls for an increase in gross building area of approximately 75,000 GSF.
- It was pointed out that the program did not identify a particular center for, or emphasis on, simulations, robotics and virtual procedures. This program area had been included in previous programs but had gained no traction with any user group other than anatomy. Cheryl Scheid pointed out that the issue had not been raised in meetings she had attended. It will be added back into the program and a user group will be identified to verify its assumptions.

MEETING NOTES

Mass State Project UMW 0301 ST1/TK&A #23024-00
UMass Medical Center Master Plan
October 29, 2004, Executive Steering Committee Meeting #2

Carol Chiles

Present:
Rick Stanton, UMMS
Bob Jenal, UMMS
Cheryl Scheid, UMMS
Tim Fitzpatrick, UMMS
Mark Duggan, UMMS
Schuyler Larrabee, DCAM
Carol Chiles, TK&A
David Owens, TK&A
Jack Synnott, TK&A

Distribution:
Attendees
Mike Williams, DCAM
Ed Tsoi, TK&A
Rick Kobus, TK&A
TK&A Team
File 23024-00

UMMS Executive Steering Committee Meeting #2

1. Carol Chiles provided a project update with the following highlights:
   - TK&A's master planning study is well underway (approximately 75% complete), with the expectation of submitting the 90% final draft report in December.
   - The need for a Research Visioning Session was brought into question. UMMS to advise on content and expert if they feel that this is a necessary activity. Tim Fitzpatrick to consult with John Sullivan and others and advise TK&A within 2 weeks.
   - TK&A/Rick Kobus continues discussions with UMMHC regarding the scope of a separate hospital master plan and programming study. UMMHC's study has not been initiated and is anticipated to extend beyond the schedule for the UMMS study.
   - Goals for today's meeting are to a) confirm program assumptions for the education center and research components and b) agree on a direction for campus design goals and organizational principles.

2. Rick Stanton and Tim Fitzpatrick provided the following update on UMMS' master plan goals:
   - Since the master plan started, UMMS has identified the need to address graduate student housing in order to be competitive. In the past four months Tufts, WPI, and Harvard have announced plans to provide more housing for the growing population of graduate students, a particular issue for recruiting international students. Consider the amenities that come along with student housing. UMMS' projected student population is 1,500 (includes 500 post-docs, 500 resident interns, 150 graduate nursing, # PhDs, 400 medical students).
   - There is a growing interest in building competitive clinical and translation research programs (dry labs). The vast majority of existing UMMS lab space is wet lab. UMMS is currently trying to quantify the need for future dry lab space.
   - Rick Stanton emphasized the desire to have a master plan that strings the campus together as a community. The campus has been growing very quickly, resulting in less informal interactions.

3. Jack Synnott delivered the final draft Education Center Program with a memo summarizing program development assumptions and outstanding issues to be addressed by UMMS.
   - Cheryl Scheid commented that the future space projections for the education center were on the high side, but reasonable for the master plan study. She agreed to review the draft document internally and provide detailed comments to Jack Synnott in two weeks.
   - Cheryl Scheid asked if the library size reflected a lack of student center space. Jack Synnott commented that several options for accommodating student center activities were addressed in the draft program document.

4. Carol Chiles presented a 10 year space projection for the research program based on UMMS' goal of achieving a top 25 NIH ranking for medical schools. Assumptions included: increase NIH grants by $80M, increase utilization to $300/ nasf, absorb unused space in the LRB, consolidate 50% of existing off campus research to main campus.
   - Bob Jenal commented that TK&A's projections were consistent with UMMS'.
   - It was noted that the space projection included both basic (wet) and clinical (dry) lab research. It is recommended that the dry research be located in the original medical school building, displacing existing wet labs to a new research building. Tim Fitzpatrick noted that the existing labs in the west wing had been recently renovated, while those in the east wing have not.
   - All present agreed that the research space projections are reasonable for the master plan study.

5. Jack Synnott presented a 10 year space projection for the healthcare program based on UMMHC's goal of achieving a top 10 medical center ranking. Taking into account national trends for this goal, TK&A has assumed a 600-bed hospital with 300-500,000 SF of ambulatory services. The projections have not been validated with UMMHC, but represent a "worst case" planning tool.
   - Rick Stanton questioned whether the Worcester market of 1.1M people would support a medical center of this size. TK&A shares this concern, stating that the top 10 goal needs definition.

6. Carol Chiles presented a list of off campus programs indicating which could potentially be relocated to the main campus. TK&A is assuming 50% of off campus research could move on campus along with the GEP, Nursing and possibly Commonwealth Medicine.
   - UMMS was asked to confirm the complete list of off campus facilities to be considered.

7. David Owens presented an overview of the campus planning implications of the above program projections.
   - The proposed scheme incorporated the "campus quad" and "green buffer" concepts from the previous design meeting.
   - This scheme illustrates that the full program projection can be accommodated on UMMS' current property if the density or FAR (floor area ratio) is increased to 1.3, building heights are kept below the LRB, optimum open space is preserved, and much of the parking is partially below-grade (terraced into the sloped topography).
   - Additional land acquisitions should be considered if the following objectives

   prevail: below-grade parking is cost prohibitive; Commonwealth Medicine is moved on campus, student housing is provided on campus, joint biotech ventures (beyond basic research projections) are developed on campus, other unforeseen programs.

8. The following are highlights of the campus planning discussion:
   - Tim Fitzpatrick agreed with the design guidelines presented and felt that the cluster of courtyards was a good idea.
   - Rick Stanton expressed concern that the separate courtyard clusters would tend to keep people in separate silos. David Owens commented that the intent was to create opportunities for interaction along the edges of the central quad. For example, spread classrooms and student activities around the central quad to create a dynamic interplay of uses.
   - The group further discussed the possibility that the assignment of various specialties into separate quads would minimize, not enhance, interaction

between specialties. Rick Stanton stated that the campus had grown fast and that opportunities for informal interaction had diminished. He cited an example of clinician researchers preferring to remain in old lab space with a direct connection to the hospital rather than move across the quad to new labs in the LRB. TK&A will explore ways to maximize the feeling of community while accommodating the nearly 4 million square feet of the future master plan.

- Tim Fitzpatrick suggested that the library could be moved to a new building and its current location renovated into a student commons.
- Bob Jenal asked about phasing, especially related to short horizons needs versus long-term land acquisitions. Short horizon needs include: new MOB; dry labs; faculty offices; social space along the quad face of the existing/old parking garage. TK&A to present phasing options at the next meeting.
- Proposed reuse of existing space needs to be better defined.

9. Next meeting is November 30, 2004. Agenda to include: further development of the campus plan along with traffic, infrastructure and landscape/site design concepts.

MEETING NOTES

Mass State Project UMW 0301 ST1/TK&A #23024-00
UMass Medical Center Master Plan
January 24, 2005, Executive Steering Committee Meeting #3

Carol Chiles

Present:
Aaron Lazare, UMMS
Tom Manning, UMMS
Rick Stanton, UMMS
Bob Jenal, UMMS
Cheryl Scheid, UMMS
Tim Fitzpatrick, UMMS
Mark Duggan, UMMS
Jean Falcone, UMMS
Schuyler Larrabee, DCAM
Nancy Denig, DDA
Ed Tsoi, TK&A
Carol Chiles, TK&A
David Owens, TK&A
Jack Synnott, TK&A

Distribution:
Attendees
Mike Williams, DCAM
TK&A Team
File 23024-00

UMMS Executive Steering Committee Meeting #3

1. Carol Chiles provided a project update with the following highlights:
   - Since the last Executive Steering Committee meeting in October, TK&A has conducted several working sessions with the consultant team and DCAM to coordinate UMMS' program and planning goals with infrastructure, traffic, civil and landscape disciplines. TK&A's master planning study is nearing completion with the expectation of submitting the 90% final draft report next month.
   - Goals for today's final steering meeting are to obtain UMMS approval on: a) program projections for the education center and research components; b) program assumptions for the hospital (understanding that UMMHC is in process with a separate strategic planning study which will not be completed for inclusion in this study); and c) agree on a direction for campus design guidelines and organizational principles.

2. Jack Synnott presented an overview of the program projections that were detailed at the October 29, 2004 steering committee meeting.

- Cheryl Scheid and Tim Fitzpatrick reported that they had reviewed the draft education program report in detail and feel that it captures the programming meeting discussions well.
- Tim Fitzpatrick confirmed that the research program projections, based on increases in NIH grants by $80M per year and increased utilization to $300/nasf aligns with UMMS' goals.
- It was noted that for purposes of this master plan, the final hospital conceptual program and massing is based on a 600-bed model with supporting diagnostic, treatment and ambulatory services (a 450-bed model was studied in a previous option). No exceptions taken.
- Program projections include allocations for relocating come off campus programs to the main campus. Candidates for relocation include: 50% of off campus research, the GEP Nursing and Commonwealth Medicine. UMMS agreed to provide for this contingency in the program projections.

3. Tom Manning asked that the master plan document address the emerging need for graduate student housing. Since the master plan started last year, UMMS has identified the need for graduate student housing in order to be competitive. Drivers of this need include: a) increased enrollment in PhD and nursing programs; b) rising cost of housing in Worcester; and c) trend at peer institutions to provide graduate student housing. UMMS' projected student population is 1,500+ (includes 500 post-docs, 500 resident interns, 150 graduate nursing, 350-450 PhDs, 400 medical students).
   - It was agreed that the master plan report would describe this need and possible locations. It will not provide a program, siting or massing studies.

4. David Owens presented an overview of the campus planning and phasing based on the above program projections.
   - Organizational site diagrams were presented which underpin the rationale for open space configuration, building orientations and parking structure locations.
   - To accommodate the full long-term program, land acquisitions would be required along the Route 9 frontage. Control of these two outparcels would relieve the need for extensive below-grade parking, allow space for the hospital's maximum foreseen growth potential and provide a mixed-use cluster on the southwest corner to accommodate Commonwealth Medicine, student housing, joint biotech ventures, retail, campus amenities or other unforeseen programs on campus.
   - A computerized animation was presented to illustrate phasing and massing concepts.

5. Nancy Denig presented landscape design concepts. She highlighted the following proposed features:

- The central quadrangle to be organized in three zones:
  1. The Lawn, a pedestrian space immediately in front of the medical school main entry. Limit vehicular access to fire trucks only.
  2. The Vehicular Forecourt, the major hospital front door automobile drop-off, access to the parking garage with a green space in the middle.
  3. The Pond, a large water feature at the south end visible from Route 9 as a signature statement for the campus, also serves as required storm water detention.
- Smaller scaled quads or green spaces in the corners of the campus for socializing and recreation.
- Therapeutic roof garden on the future hospital garage to the east.
- Walking/recreational/exercise trail along the circumference of the campus.
- Memorial plaques and markers at various seating walls and paved areas in the quadrangles.
- Selective treatments of manicured lawns, native grasslands (sustainable design), stone walls along Route 9 and tree-lined paths/roads.
- Accessible walkways and paths throughout the site.

6. Infrastructure Overview: VanZelm Heywood & Shadford is preparing a conceptual infrastructure report based on site visits, review of available documentation and discussion with UMMS staff. The highlights of their observations include:
   - Construct a second power plant at the northwest corner and complete the utility loop around campus to relieve the risks associated with a single point power and steam supply to critical campus functions.
   - Consider phasing in more sustainable, energy-efficient buildings and systems to reduce the size of projected future loads.

7. Traffic Study: VHB has been engaged to study traffic and parking impacts of the future program buildout. Preliminary recommendations include:
   - No new curb cuts or direct parking access from Plantation.
   - Shift future traffic load to Lake to mitigate increased congestion on Plantation.
   - Reconfigure South Road/Lake intersection to improve campus access from the east.

8. UMMS and DCAM made the following comments to the presentation:
   - Tom Manning: Take into consideration that pedestrians will always take the shortest path rather than follow prescribed walkways.
   - Tom Manning: Include commercial space along the front (quad side) of the old parking structure (between LRB and medical school). Examples: banking/ATM, insurance, pharmacy or convenience shop.
   - Tom Manning: Designate some of the purple hospital space as potential clinical research. Don't need to change the design, but mention it.

- Rick Stanton: The interrelated mission of the three enterprises means that the three use designations will not be distinct and separate. Example: Education training spaces will be embedded in clinical space. The space must flexibly accommodate an evolving back and forth use assignment.
- Tom Manning: Not a top priority to move Commonwealth Medicine on campus. The southwest cluster should be considered a flex parcel that could accommodate a mixed use of office, housing, campus amenities, or other commercial activities.
- Tim Fitzpatrick: The new parking garage was designed to accommodate the Phase I MOB parking, so do not show a new hospital garage for Phase I.
- Cheryl Scheid: Show only one bed tower in Phase I.
- Tom Manning: Add color to Biotech 1 & 2 and Brown Rudnick across Plantation to show as part of the existing UMMS buildout.
- Tim Fitzpatrick summarized the Phase I buildout to include:
  1. MOB (parking already constructed in new garage)
  2. First new bed tower + parking
  3. One new research and education building approximately 200,000 SF + parking
- Rick Stanton commented that the larger UMMS community would be interested to know what plans are being made for campus amenities such as housing, daycare, faculty club, and amphitheater. TK&A to mention possible locations in the final report.
- Schuyler Larrabee commented that today's presentation was very good, thorough and convincing.

9. Next Steps
   - TK&A will incorporate these remarks into the final 90% master plan to be submitted February 28, 2005.
   - UMMS/DCAM final review comments due on March 31, 2005.
   - Tom Manning requested that TK&A present the master plan results to the UMMS community including representatives of the hospital, faculty, Board, internal users. Tim Fitzpatrick to organize and advise.
   - UMMS will use the master plan report to support their MEPA filing which is needed to permit the MOB project.