



The Potomac Yard Land Bay E

Arlington, VA

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Construction Management
Technical Assignment #1
October 5, 2009

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Executive Summary:

Technical assignment 1 takes an in-depth look at the construction management aspects of the Potomac Yard Land Bay E project that is located in Arlington Virginia. This project is part of a 15-acre development project that is positioned near Reagan National Airport south of Crystal City and between Route 1 and the George Washington Parkway. This project is one of many buildings that have been constructed since 2004. All of the buildings constructed on the old train yard site serve for a variety of uses that include: office, residential, hotel and retail space.

The Potomac Yard Land Bay E project includes two towers, both nine-stories that total 369,300 SF of rentable office space. Also included on this project is a three level underground parking garage that totals 235,000 SF with the capability of holding up to 600 vehicles. Finally the project includes an interim landscape with a small roundhouse structure that could house a Starbucks or an Apple Store. Both Land Bay E A and B have similar building facades that include both flat and curved glass curtain walls and architectural precast with punched out glazing.

The Land Bay E project is a 20-month design-bid-build with a GMP contract. The \$75 million GMP contract was agreed upon between James G. Davis Construction Corporation and The Meridian Group. The project is projected to achieve a LEED certification of Gold by its completion. Some of the items used on the project to achieve the LEED status are a white TPO roofing membrane, recycling stations on every floor, locally manufactured materials and a variety of construction techniques. There are two contractors that were involved in the recycling and disposal of materials throughout the project.

The technical assignment includes the analysis of a variety of items from the Potomac Yard Land Bay E project. The items in this technical analysis are the project schedule, building systems summary, project cost evaluation, site plan of existing conditions, local conditions, client information, project delivery system and the staffing plan for the general contractor of the project.

Project Schedule Summary:

See Appendix A for Project Schedule

The Land Bay E project was broken into three different phases. The three phases of the project were as follows: construction of the three parking levels, construction of building B and then the construction of building A. Although these three phases of construction started at separate times the work on all three of the phases was going on concurrently but at different stages.

Foundation Sequence

Due to the soil conditions and the site location's water table, shallow foundations like spread footings were not able to be used. Instead precast concrete piles were needed to be used for the foundation of this structure. Due to the larger footprint of the underground parking garage, a large area was needed to be excavated to install a soldier beam and lagging soil retainage system to keep the excavation from caving during the pile installation. Once this was completed the garage structure was ready to commence.



Structural Sequence

The structural sequencing of the project began with placing the cast in place columns for the parking levels and then placing the post tension concrete slabs for the parking decks. After the garage levels were completed the construction of building B began with the placing in the northern portion of the structure. Finally building A followed after building B started. Both of the buildings were having the concrete structure being placed simultaneously but at different stages.

Finish Sequence

After the structure of the buildings was completed the finishes could then proceed. Due to the fact that this project is just a base building and not a total interior fit out the buildings were not watertight when the core finishes began. The reason for this is that only the building cores like the bathrooms, janitor closets, mechanical and

electrical rooms which are located in the center of the buildings could be completed because they are isolated from the outside conditions. When installing the finishes in these areas the rooms were supplied with conditioned air. The lobby areas were also having the finishes installed before the building was sealed. This required the use of temporary doors, walls, air barricades and dehumidifiers.

Building Systems Summary:

Yes	No	Work Scope
	X	Demolition
	X	Structural Steel Frame
X		Cast in Place Concrete
X		Precast Concrete
X		Mechanical System
X		Electrical System
X		Masonry
X		Curtain Wall
X		Support of Excavation

Demolition:

The Potomac Yard Land Bay E project required no demolition because its prior use as a train yard. This site was relatively level with minimal structures. The project is one of many buildings that the owner is having built on their 15 acre facility. There has been previous construction on the 15-acre lot therefore making the Land Bay E site of 1.35 acres ready for construction to begin.

Structural Steel:

The Land Bay E project has minimal structural steel due to the fact that it is predominately a concrete structural system with post-tensioning elevated concrete slabs. The steel that is used in this project is cold-formed light steel that is used for some structural applications in the penthouse areas and also used for framing purposes. The structural steel studs on this project have minimum yield strengths of 50,000 psi for 16 gauge and thicker materials, and 33,000 psi for materials thinner than 16 gauge.

Cast In Place Concrete:

The Land Bay E project is mostly constructed with CIP concrete. It uses a variety of concrete strengths throughout the building. The building uses 5000 psi concrete for the slabs and beams, 4500 psi concrete for the slab on grade, 4000 psi concrete for the walls and piers, 5000 psi for the pile caps and 2500 psi concrete for CMU fill. All concrete ramps, parking levels, plaza levels and slabs shall have a minimum of 28 day curing time. All of the typical floors in the buildings are constructed of elevated post tension concrete slabs. All of the reinforcing steel being used on this project shall be deformed billet steel conforming to ASTM A615, Grade 60. For any of the reinforcing steel that is being used on the Land Bay E project that is exposed to the elements is coated with an epoxy coating to retard the degradation of the product. The concrete placement was completed with crane and bucket, concrete pump and

Georgia buggies by Miller and Long. There were two tower cranes used in this process of placing the concrete.



Precast Concrete:

There are two types of precast concrete used on the Land Bay E project. One of the types is prestressed concrete that is used for structural purposes as the piles. The reason for the use of piles on this project is due to the surrounding soil types and the depth of the water table. This project is within a small distance of the water table thus requiring a different type of foundation and a dewatering system. The piles that are used on the Potomac Yard Land Bay E project are 14'x14' that can resist 125 tons of force. These piles were driven into the ground to bear on natural soil which was on average about 30' below the lowest floor. The other type of precast concrete that was utilized on this project was used for architectural purposes. These panels are used on the façade of the buildings and are designed to anchor onto the structural concrete frame. The precast panels must also resist a force of 6000 pounds and not fail.

Mechanical System:

The mechanical contractor involved on the Land Bay E project is W.E. Bowers and Associates. The mechanical system in the Land Bay E buildings consist of 8 AHUs, 3 cooling towers, 2 chillers, both wet and dry sprinkler systems and VAV units that operate on every floor to regulate the air temperature. Between the two towers of the Land Bay E project there are 9 elevators, 8 of which service all of the floors including the parking levels. The other elevator is a hydraulic elevator that sole purpose is to serve the LA Fitness center. In the parking levels there are two garage air intake shafts and two garage air exhaust shafts. The building houses mechanical rooms on all of the floors except for the two lower P-levels. The combine size of the penthouses for both of the buildings for the Land Bay E project total is 15,430 SF which house the (2) chillers, (3) cooling towers, (8) AHUs and chilled water pumps.

Electrical System:

The electrical contractors involved on the Land Bay E project are MCLA and J.E. Richards. The electrical system that serves both of the buildings of the Potomac Yard Land Bay E project consists of a 277/480V, phase, 4W with a 3000A breaker service. The main service to the buildings is brought inside on the north face of the building system on the P1 level. The main electrical room is situated on the P1 level near the loading dock. Throughout the project there are 36 different lighting fixtures in the buildings A and B and there are 10 different lighting fixtures that are installed throughout the P-levels.

Masonry:

The masonry in this project is strictly used for load bearing purposes. There is no brick or architectural stone usage on the buildings. The concrete masonry units used on this project are to be placed with type N mortar joints and type S mortar joints for exterior walls. The masonry cells in the buildings are to be filled continuously with grout and reinforced. Wall ties were also used when being connected to steel beams.



Curtain Wall:

A curtain wall system was used for the curved portion of building B's façade and between both buildings A and B. On the larger portion of the project a precast architectural panel system with a punch out window glazing system would be put into place.

Support of Excavation:

The design and installation of support of excavation was required for the Land Bay E project due to the soil and water conditions. The site was supported by sheet piling system to protect against caving. The excavation supports were not removed from the site until the structural system was braced. Once the excavation system was removed then proper backfilling of the site was completed.

LEED:

This project is projected to achieve a LEED certification of gold by the completion of the construction. There were many items that were used on the Land Bay E project that helped to achieve this status. Some of the materials and methods that were used on the project was a white TPO roofing membrane, recycling stations placed on every typical floor, recycling disposal service, additional bicycle racks added to the parking levels, local building materials and local transportation access. The reason that more bicycle racks were added is because of the large number of motor vehicle parking spots. The recycling service was provided by two contractors on this project. The two contractors involved were American Disposal and Miller & Long/NOVA. These two companies sorted land debris, asphalt, concrete and masonry, metals, drywall, wood, cardboard, paper, plastic and non-disposable materials. From this process there was 1,422.86 tons of recycled material and there was 93.94% of trash diverted from landfills.

Project Cost Evaluation:

Cost Summary

Potomac Yard Land Bay E	Cost	Cost/SF
Construction Cost	\$69,646,805	\$112.53
Total Building Cost	\$76,558,826	\$123.70

Building System Cost

Building System	Cost	Cost/SF
CIP Concrete	\$15,700,000	\$25.37
Precast	\$2,570,000	\$4.15
Glazing and Composite Panels	\$11,070,000	\$17.89
Elevators	\$2,222,427	\$3.59
HVAC/ Plumbing	\$9,675,000	\$15.63
Electrical	\$5,450,730	\$8.81
Fire Protection	\$974,400	\$1.57

D4 Historical Data Estimate-

See Appendix B for D4 estimate sheets

Building Data

Name	Size	Floors	Bldg. Cost
Westchase Corporate Center	308,500	6	10,492,634
Ha-Lo Headquarters	267,334	7	37,643,382
Willow Oaks III	407,042	7	16,757,728

Parking Garage Data

Name	Size	Floors	Bldg. Cost
Park Place Parking Garage	129,024	5	3,158,033
Parking Garage	144,000	5	4,492,052
Renaissance Parking Garage	301,000	10	18,288,595
Mercy Health Parking Garage	220,000	4	6,581,720

When using D4 Cost Estimating Software for the Potomac Yard Land Bay E project the above projects were selected from the historical database. The reason for two estimates is because there were no projects that incorporated an underground parking garage with the building. The reason that the selected projects were used in the estimate is because they had the similar use, size and number of floors

respectively. When obtaining the two estimates and adding them together to obtain the total project cost of \$63,384,284. This total was about \$13,174,542 short of the original project estimate.

RS Means Estimate-

See Appendix C for RS Means data sheets

	Building A	Building B	Parking Garage
Perimeter	333 LF	298 LF	647 LF
Square Footage	188,095 SF	181,997 SF	248,842 SF
Floor Height	12.5'	12.5'	10'
Elevators	4	5	8 (used in bldgs)

Building A

Base Unit Cost	\$148.81	Adjustment	Notes
Story Adjust	.5	.69	Per 1Ft
Perimeter Adjust	247.95	-7.35	Per 100LF
Special Foundation		.49	
Elevators		0	Per Car
Subtotal:		142.64	
Location:	.93	132.66	Arlington, VA

Total Bldg. Cost: \$24,951,719.84

Building B

Base Unit Cost	\$149.18	Adjustment	Notes
Story Adjust	.5	.69	Per 1Ft
Perimeter Adjust	273.16	-8.40	Per 100LF
Special Foundation		.49	
Elevators	1	3.66	Per Car
Subtotal:		145.62	
Location:	.93	135.43	Arlington, VA

Total Bldg. Cost: \$24,644,526.39

Parking Garage

Base Unit Cost	\$148.81	Adjustment	Notes
Story Adjust	0	0	Per 1Ft
Perimeter Adjust	247.95	-3.96	Per 100LF
Special Foundation		.57	
Elevators		0	Per Car

Subtotal:		67.14	
Location:	.93	62.44	Arlington, VA

Total Bldg. Cost: \$15,537,744.25

Total Project Cost: \$65,133,990.48

Comparison between D4 and RS Means

When comparing the two estimates for the Potomac Yard Land Bay E project it was determined that they were both over \$10 million short from the original estimate. The reasons that the estimates could be inaccurate from the real project cost is:

- The foundation piles that needed to be driven into solid earth may not have been taken into account.
- The projects were not quite the same as the Land Bay E project in the sense that the buildings were built on top of the parking garage.
- The dewatering during excavation and the dewatering systems needed for permanent usage may not have been taken into account.
- Location factors seem to be a little low considering it is so close to Washington DC it would seem that it should be closer to 1.0 and not .93 for Arlington, VA.

Site Plan of Existing Conditions:

See Appendix D for site plan of existing conditions

The Potomac Yard Land Bay E project is located in Arlington, VA along US Route 1 and Glebe Road. The Land Bay E West project is one of eight buildings that are part the Potomac Yard complex. Land Bay E has two buildings that border to the north, one to the east and one to the south. All of the buildings names are Land Bay with different letters A-F. The buildings that surround Land Bay E West range from a variety of uses which consist of residential, office, retail and hotel.

The existing utilities around the site were run on the south border of the site while the new utilities were brought in on the northern border. There are several new light poles that will be installed surrounding the building along with new walkways. Once the parking deck the parking was completed Center Park was installed on top.

Local Conditions:

The construction industry in the Washington DC metro areas is most commonly Cast in Place Concrete (CIP). To complete the structural system along with the CIP is most commonly post tension concrete slabs. The reason for the use of concrete structures in this area is due to the height restrictions placed within the District. Although these height restrictions do not apply to the surrounding cities this form of construction is highly adopted as a common practice. With the high demand for concrete structures in this area it limits the possibilities for steel erectors to become as profitable.

The project is located in an area of Arlington that predominately houses commercial office buildings along with some residential condos. Due to the condense area parking lots are at a minimum thus most buildings utilize parking decks and underground parking. Luckily during construction there is ample room on the northern portion of the sight for workers and management personnel to park outside the construction site. Although there is parking spots available it is appreciated that carpooling occur.

The type of projects that usually occur in the Washington DC metro area is predominately government buildings and related structures along with private office buildings. Being that Washington DC is the nation's capitol there is a lot of large businesses in the surrounding area like BAE Systems, Northrup Grumman and Innovative Defense Tech that require large scale sophisticated buildings. Along with big business are the tourist attractions all over the area both government and historically related like the Pentagon and the Washington Monument. Both of these businesses require hotels, retail, residential and office space which the National Gateway at Potomac Yard provides.

Currently in the country's economic state of recovering from a recession there is unfortunately a reduced need for large office space. As of now there are two occupants that plan to move into the Land Bay E buildings. These two companies include LA Fitness and Wachovia/ Wells Fargo Bank. The rest of the building is currently awaiting occupancy.

The Potomac Yard site contains soft and compressible Stratum B1 soils that do not support the usage of shallow foundations like spread footings and mat slabs. Instead the use of deep foundations like precast concrete piles was recommended with a compressive strength of at least 4,000 psi. The piles are recommended to be of 30 feet in length below the lowest floor level. The water table was found to be at elevations of 0 to +15 feet thus the use of dewatering systems during construction were utilized. After construction pumping systems will still need to be used like sump pumps stations that are located in the lower P-levels.

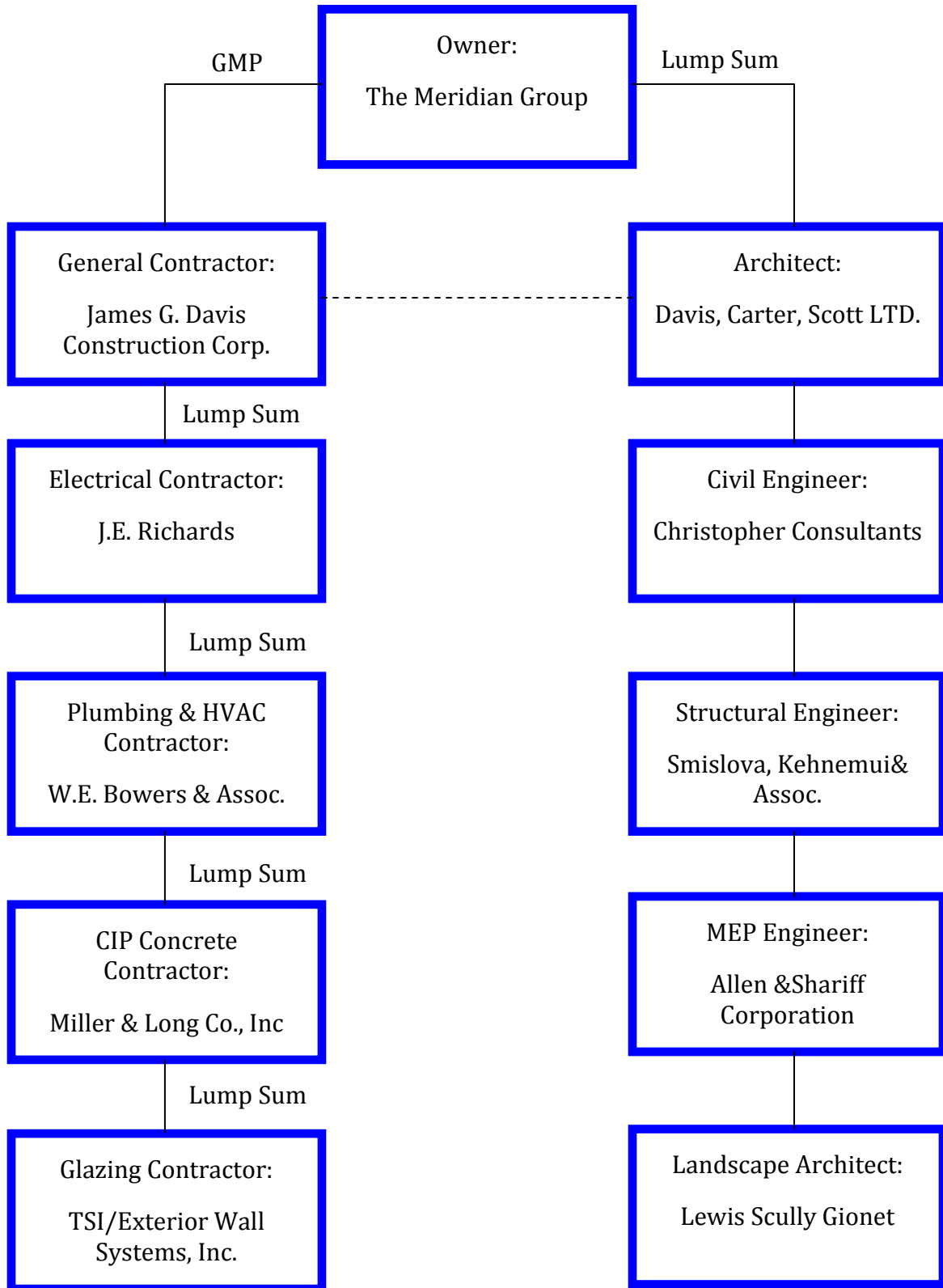
Client Information:

The owner of the Potomac Yard Land Bay E buildings is The Meridian Group that is located in Bethesda Maryland. They are a large real estate and investment development firm that has complete over \$2.8 billion in transactions. The Meridian Group maintains a focus on the Washington DC Metropolitan area and also has assets in Baltimore, MD, Charlotte, SC and West Palm Beach, FL. The company has successfully acquired over 7 million SF of industrial and office space and 439 acres since 1993. Property is acquired, structured, constructed, capitalized and managed by the Meridian Group. All of these qualities make this client very experienced with construction practices.

The Potomac Yard Land Bay E buildings are high-class office spaces with class-A materials to attract high-end tenants. On the plaza level of the eastern building there are a variety of special features catered to LA Fitness like basketball courts and other fitness rooms. On the P1 level of the western building there is a swimming pool, basketball court and more fitness club space. The Lobbies of the buildings boast elaborate wood and stone decorative wall and floor coverings. The elevators are covered in stainless steel and are illuminated with high-class lighting fixtures.

The owner for this project was concerned about many issues. Some of the issues that the owner was concerned about was that they were obtaining a quality product for the best value. The owner was also concerned keeping the construction process on schedule without sacrificing safety. The schedule was very important to the owner of the Land Bay E project because the sooner the construction of the buildings were completed the sooner they could rent out the space and begin making money on their investment. Finally the materials that were used on the project were of concern to the owner because they wanted to house high end clients in their buildings. For this reason they had selected higher end finishes to be installed throughout the buildings.

Project Delivery Systems:

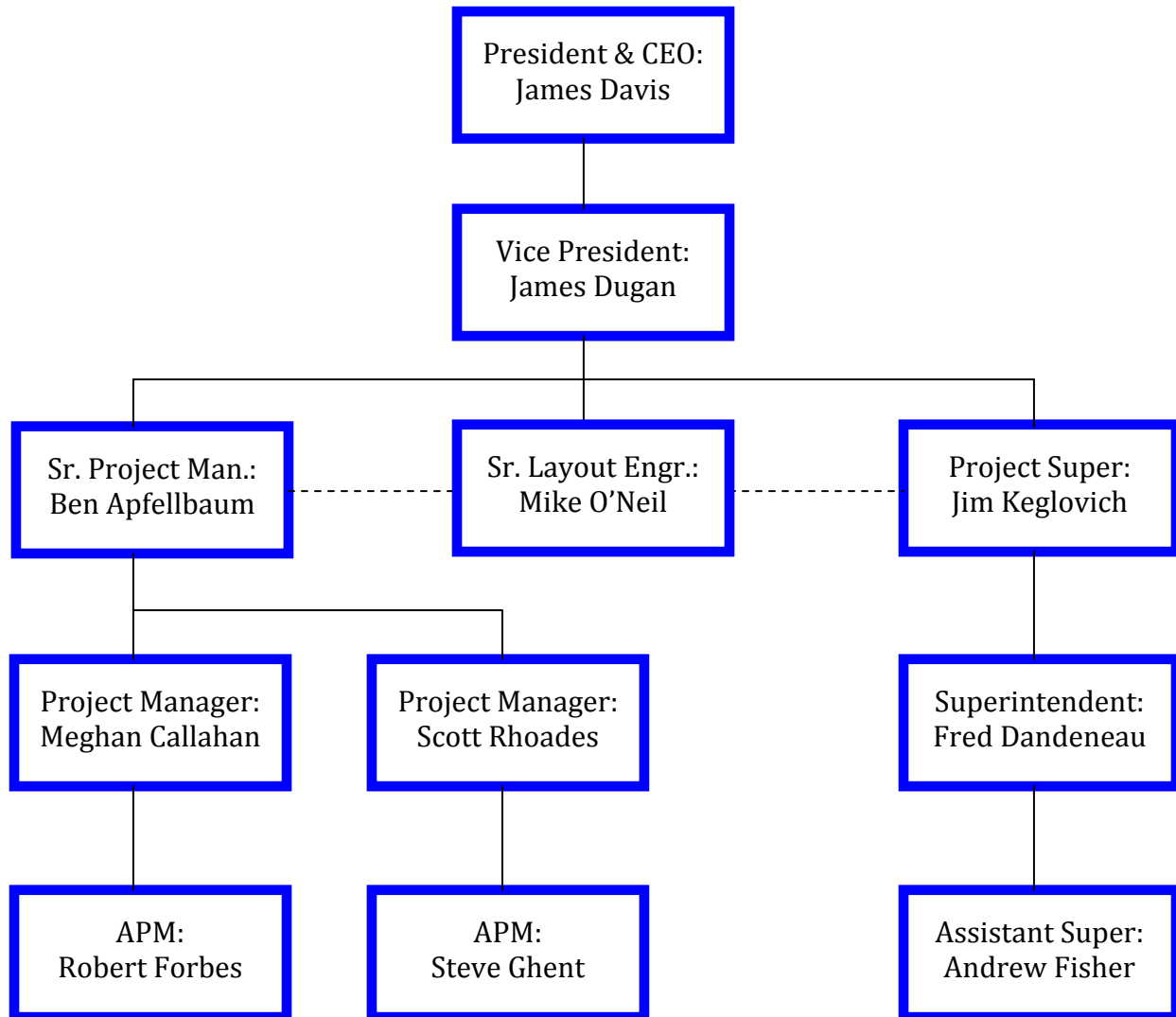


The Potomac Yard Land Bay E Project has many key players in delivering this project successfully as shown in the previous project delivery diagram. On this project there is the owner which is The Meridian Group which is based out of Bethesda, MD. The Meridian Group is constructing this project with a goal of renting it for mainly office space with the ground floor being a health club. As of now there are two tenants which are LA Fitness and Wachovia/ Wells Fargo Bank. The Land Bay E project is delivered as a design bid build with a negotiated GMP contract.

The general contractor on the Land Bay E project is James G. Davis Construction Corporation and the architect is Davis, Carter, Scott LTD. DCS LTD. has contracted several other firms to help with the design process. Christopher Consultants was hired to perform the civil engineering for the project and the site work design. The structural engineer hired for this job was a company based out of Fairfax, VA which was called Smislova, Kehnemui & Associates. The Allen and Shariff Corporation in charge of designing all of the mechanical, electrical and plumbing systems for the Land Bay E project and Lewis Scully Gionet was the landscape architect hired to design the finishes outside the building complex.

The subcontractors that DAVIS Construction used for the Land Bay E project were selected on a BAFO, best and final offer of the lowest offer with the comprehensive scope. DAVIS bonds all of the subcontractors over \$150,000 for both payment and performance. For this project DAVIS did purchase liability insurance for work performed on the Land Bay E project. The main subcontractors that were selected for the project are listed above in the project delivery diagram.

Staffing Plan:



James G. Davis Construction has placed both management and field members on the Land Bay E project to accommodate the size and scope of the project. Throughout the project the personnel needs to change in order to accommodate different stages of construction. During some stages of the project more personnel with a variety of expertise will be needed. Overall the project staffing structure looks similar to the above diagram throughout the project.

Assistant Project Manager:

The assistant project manager is responsible for posting and submitting RFIs and submittals. Also the APM is in charge of tracking change documents and shop drawings.

Assistant Superintendent:

The assistant superintendent is responsible for updating the schedule and dealing with subcontractors on a daily basis. The assistant superintendent is also in charge of helping with the site coordination.

Project Manager:

The project manager is responsible for the completion of his or her portion of the project. They must keep track of change orders, ticket items, make payments ensure that budget items are met.

Superintendent:

The superintendent is responsible for maintaining the schedule by making sure that the field labor is producing the required amount of work to complete the project on time. Additionally the superintendent is responsible for managing and coordinating the work force on the job site, preparing for deliveries and ensuring site safety.

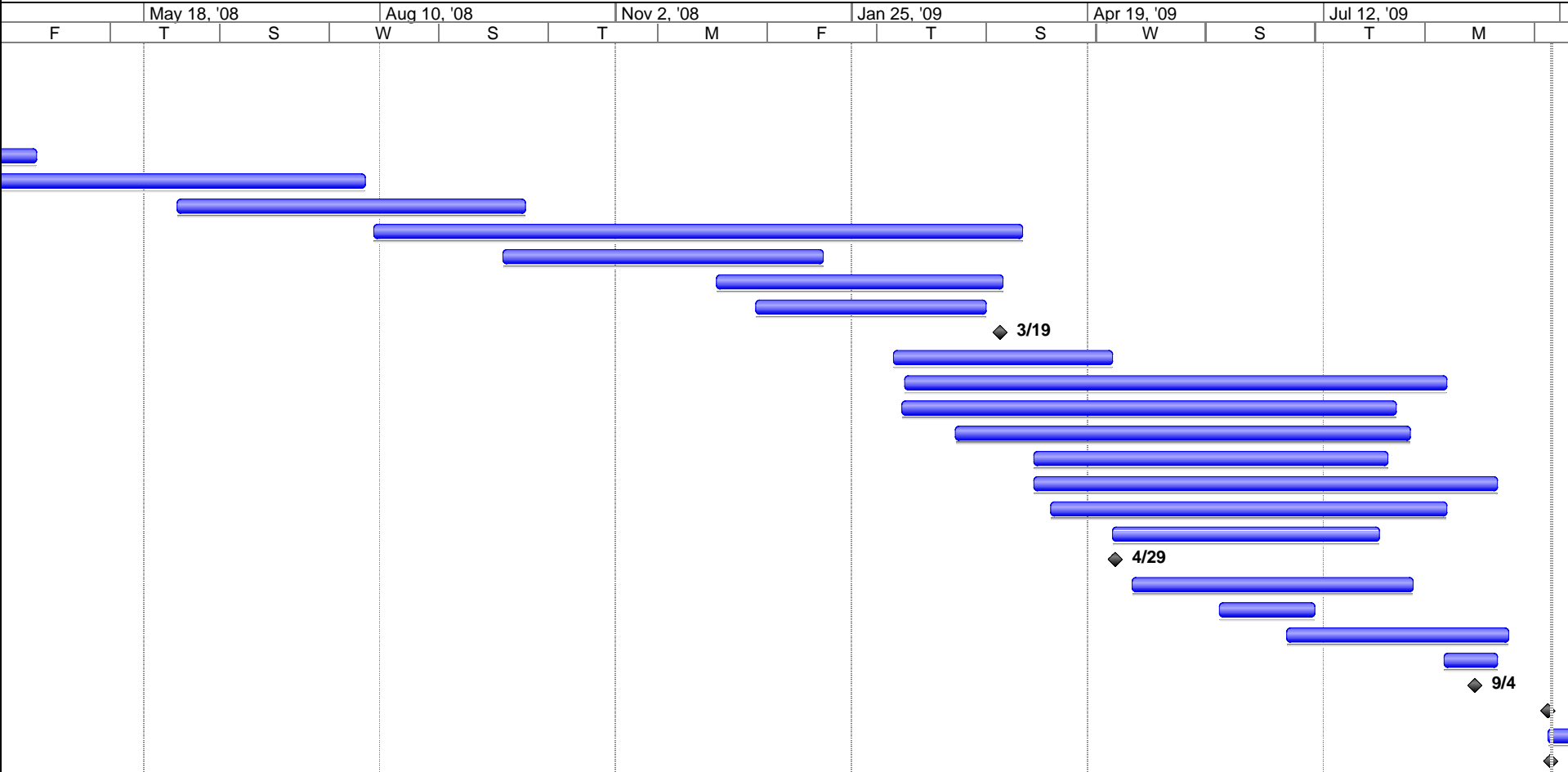
Appendix A: Project Schedule

Project Summary Schedule




ID	Task Name	Duration	Start	Finish	17, '07				Sep 9, '07				Dec 2, '07		Feb 24, '08
					F	T	S	W	S	T	M				
1	Proposal to Owner	0 days	Fri 7/13/07	Fri 7/13/07	◆ 7/13										
2	Notice to Proceed	0 days	Tue 8/14/07	Tue 8/14/07		◆ 8/14									
3	Preconstruction	158 days	Tue 8/14/07	Thu 3/20/08											
4	Owner Receiving Permits	76 days	Thu 9/13/07	Thu 12/27/07											
5	Site Development	71 days	Wed 1/2/08	Wed 4/9/08											
6	Sheeting/ Shoring	104 days	Wed 3/12/08	Mon 8/4/08											
7	Foundation Piles/ Pile Caps	88 days	Fri 5/30/08	Tue 9/30/08											
8	Site Utilities	165 days	Fri 8/8/08	Thu 3/26/09											
9	Ground Floor Concrete	82 days	Tue 9/23/08	Wed 1/14/09											
10	Above Grade Concrete Structure B	74 days	Mon 12/8/08	Thu 3/19/09											
11	Above Grade Concrete Structure A	60 days	Mon 12/22/08	Fri 3/13/09											
12	Top Out Building B	0 days	Thu 3/19/09	Thu 3/19/09											
13	Arch Precast Bldg B	56 days	Mon 2/9/09	Mon 4/27/09											
14	Building B Core Finishes	137 days	Fri 2/13/09	Mon 8/24/09											
15	Main Lobby Interior Bldg B	126 days	Thu 2/12/09	Thu 8/6/09											
16	Building A Core Finishes	116 days	Tue 3/3/09	Tue 8/11/09											
17	MEP and Sprikler Bldg B	90 days	Tue 3/31/09	Mon 8/3/09											
18	Elevators Bldg B	119 days	Tue 3/31/09	Fri 9/11/09											
19	Elevators Bldg A	101 days	Mon 4/6/09	Mon 8/24/09											
20	MEP and Sprinkler Bldg A	69 days	Tue 4/28/09	Fri 7/31/09											
21	Top Out Building A	0 days	Wed 4/29/09	Wed 4/29/09											
22	Arch Precast Bldg A	72 days	Tue 5/5/09	Wed 8/12/09											
23	MEP Garage Levels	24 days	Fri 6/5/09	Wed 7/8/09											
24	Site Work/ Landscaping	57 days	Mon 6/29/09	Tue 9/15/09											
25	Inspections	15 days	Mon 8/24/09	Fri 9/11/09											
26	Building A&B Watertight	0 days	Fri 9/4/09	Fri 9/4/09											
27	Substantial Completion	0 days	Wed 9/30/09	Wed 9/30/09											
28	Punchlist	10 days	Wed 9/30/09	Tue 10/13/09											
29	Project Completion	0 days	Thu 10/1/09	Thu 10/1/09											




Drew Heilman AE Senior Thesis	Task		Milestone	◆	External Tasks	
	Split		Summary		External Milestone	◆
	Progress		Project Summary		Deadline	↓

Project Summary Schedule



Drew Heilman
AE Senior Thesis

Task 
 Split 
 Progress 

Milestone 
 Summary 
 Project Summary 

External Tasks 
 External Milestone 
 Deadline 

Appendix B: D4 Estimate

Statement of Probable Cost

Land Bay E - Oct 2008 - VA - Arlington

Prepared By: Drew Heilman AE Senior Thesis 2010 The Pennsylvania State University University Park, Pa 16802 717.873.1210 Fax:	Prepared For: Penn State AE Department 104 EUA University Park, Pa 16802 Fax: 216643 Office PIL PRE MEM CON NEW
Building Sq. Size: 369300 Bid Date: No. of floors: 9 No. of buildings: 2 Project Height: 138.32 1st Floor Height: 1st Floor Size:	Site Sq. Size: 216643 Building use: Foundation: Exterior Walls: Interior Walls: Roof Type: Floor Type: Project Type:

Division	Percent	Sq. Cost	Amount
00 Bidding Requirements	3.15	3.87	1,430,841
Bidding Requirements	3.15	3.87	1,430,841
01 General Requirements	12.05	14.83	5,476,682
General Requirements	12.05	14.83	5,476,682
02 Site Work	5.76	7.09	2,619,383
Site Work	5.76	7.09	2,619,383
03 Concrete	23.48	28.90	10,672,842
Concrete	23.48	28.90	10,672,842
04 Masonry	1.54	1.89	699,400
Masonry	1.54	1.89	699,400
05 Metals	7.60	9.35	3,452,036
Metals	7.60	9.35	3,452,036
06 Wood & Plastics	0.31	0.39	142,375
Wood & Plastics	0.31	0.39	142,375
07 Thermal & Moisture Protection	1.36	1.67	617,607
Thermal & Moisture Protection	1.36	1.67	617,607
08 Doors & Windows	15.30	18.82	6,951,740
Doors & Windows	15.30	18.82	6,951,740
09 Finishes	3.59	4.42	1,632,282
Finishes	3.59	4.42	1,632,282
10 Specialties	1.89	2.33	860,576
Specialties	1.89	2.33	860,576
11 Equipment	0.08	0.10	35,856
Equipment	0.08	0.10	35,856
12 Furnishings	1.06	1.31	482,962
Furnishings	1.06	1.31	482,962
14 Conveying Systems	4.13	5.08	1,875,990
Conveying Systems	4.13	5.08	1,875,990
15 Mechanical	12.02	14.79	5,461,850
Mechanical	12.02	14.79	5,461,850
16 Electrical	6.68	8.22	3,036,306
Electrical	6.68	8.22	3,036,306
Total Building Costs	100.00	123.07	45,448,726
Total Non-Building Costs	100.00	0.00	0

Total Project Costs

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Statement of Probable Cost

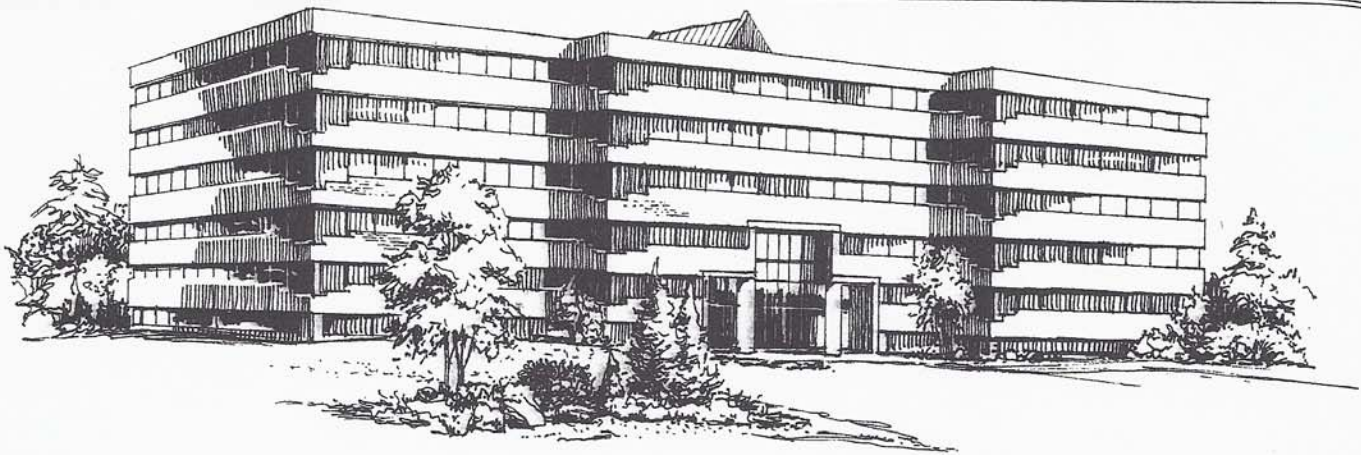
Land Bay E Parking - Oct 2008 - VA - Arlington

Prepared By: Drew Heilman AE Senior Thesis 2010 The Pennsylvania State University University Park, Pa 16802 717.873.1210 Fax: Building Sq. Size: 235000 Bid Date: No. of floors: 3 No. of buildings: 1 Project Height: 1st Floor Height: 1st Floor Size:	Prepared For: Penn State AE Department 104 EUA University Park, Pa 16802 Fax: 23677 Building use: Commercial Foundation: PIL Exterior Walls: CON Interior Walls: Roof Type: Floor Type: CON Project Type: NEW
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Division		Percent	Sq. Cost	Amount
00	Procurement and Contracting Require	4.74	3.62	850,145
	Procurement and Contracting Require	4.74	3.62	850,145
01	General Requirements	3.65	2.78	654,152
	General Requirements	3.65	2.78	654,152
02	Site Work	10.64	8.12	1,907,629
	Site Work	10.64	8.12	1,907,629
03	Concrete	52.89	40.36	9,485,701
	Concrete	52.89	40.36	9,485,701
04	Masonry	0.39	0.29	69,281
	Masonry	0.39	0.29	69,281
05	Metals	4.47	3.41	802,395
	Metals	4.47	3.41	802,395
06	Wood & Plastics	0.06	0.04	10,052
	Wood & Plastics	0.06	0.04	10,052
07	Thermal & Moisture Protection	1.83	1.40	328,018
	Thermal & Moisture Protection	1.83	1.40	328,018
08	Doors & Windows	6.68	5.10	1,197,760
	Doors & Windows	6.68	5.10	1,197,760
09	Finishes	0.59	0.45	105,647
	Finishes	0.59	0.45	105,647
10	Specialties	0.37	0.28	66,427
	Specialties	0.37	0.28	66,427
11	Equipment	0.73	0.55	130,198
	Equipment	0.73	0.55	130,198
14	Conveying Systems	1.76	1.35	316,147
	Conveying Systems	1.76	1.35	316,147
15	Mechanical	3.89	2.97	698,528
	Mechanical	3.89	2.97	698,528
16	Electrical	4.60	3.51	825,422
	Electrical	4.60	3.51	825,422
21	Fire Suppression	0.37	0.28	65,725
	Fire Suppression	0.37	0.28	65,725
22	Plumbing	0.52	0.40	93,706
	Plumbing	0.52	0.40	93,706
26	Electrical	1.83	1.40	328,625
	Electrical	1.83	1.40	328,625

Total Building Costs	100.00	76.32	17,935,558
Total Non-Building Costs	100.00	0.00	0
Total Project Costs	--	--	17,935,558

Appendix C: RS Means



Model c
with 12
of floor

A. SUBS

1010	Stan
1020	Spe
1030	Slab
2010	Base
2020	Base

B. SHELL

B10	
1010	Floc
1020	Ro

B20

2010	Exte
2020	Exte
2030	Exte

B30

3010	Roc
3020	Roc

C. INTER

1010	Par
1020	Inte
1030	Fitti
2010	Sta
3010	Wc
3020	Flo
3030	Cel

D. SERV

D10	
1010	Ele
1020	Esc

D20

2010	Plu
2020	De
2040	Ra

D30

3010	En
3020	He
3030	Cc
3050	Ter
3090	Or

D40

4010	Sp
4020	Str

D50

5010	Elk
5020	Liq
5030	Cr
5090	O

E. EQU

1010	C
1020	In
1030	Ve
1090	C

F. SPEK

1020	In
1040	S

G. BU

C
A

Costs per square foot of floor area

Exterior Wall	S.F. Area	20000	40000	60000	80000	100000	150000	200000	250000	300000
	L.F. Perimeter	260	360	400	420	460	520	600	640	700
Precast Concrete Panel	Steel Frame	219.75	191.10	176.00	167.10	162.85	155.70	152.70	150.00	148.55
	R/Conc. Frame	215.70	186.70	171.55	162.60	158.30	151.10	148.10	145.40	143.95
Face Brick with Concrete Block Back-up	Steel Frame	212.30	185.15	171.35	163.35	159.45	152.90	150.15	147.80	146.45
	R/Conc. Frame	205.90	179.90	166.50	158.65	154.85	148.55	145.85	143.50	142.20
Limestone Panel Concrete Block Back-up	Steel Frame	256.90	216.70	194.95	182.05	175.95	165.60	161.20	157.30	155.20
	R/Conc. Frame	252.25	212.05	190.25	177.40	171.25	160.90	156.55	152.65	150.55
Perimeter Adj., Add or Deduct	Per 100 L.F.	27.40	13.65	9.10	6.80	5.50	3.65	2.75	2.25	1.90
Story Hgt. Adj., Add or Deduct	Per 1 Ft.	5.70	3.90	2.90	2.30	2.05	1.50	1.35	1.15	1.05

For Basement, add \$ 36.40 per square foot of basement area

The above costs were calculated using the basic specifications shown on the facing page. These costs should be adjusted where necessary for design alternatives and owner's requirements. Reported completed project costs, for this type of structure, range from \$74.60 to \$219.35 per S.F.

Common additives

Description	Unit	\$ Cost
Clock System		
20 room	Each	16,000
50 room	Each	39,100
Closed Circuit Surveillance, One station		
Camera and monitor	Each	1850
For additional camera stations, add	Each	1000
Directory Boards, Plastic, glass covered		
30" x 20"	Each	595
36" x 48"	Each	1,450
Aluminum, 24" x 18"	Each	600
36" x 24"	Each	675
48" x 32"	Each	980
48" x 60"	Each	2025
Elevators, Electric passenger, 5 stops		
2000# capacity	Each	158,700
3500# capacity	Each	167,200
5000# capacity	Each	170,700
Additional stop, add	Each	13,600
Emergency Lighting, 25 watt, battery operated		
Lead battery	Each	282
Nickel cadmium	Each	805

Description	Unit	\$ Cost
Intercom System, 25 station capacity		
Master station	Each	2650
Intercom outlets	Each	169
Handset	Each	470
Smoke Detectors		
Ceiling type	Each	187
Duct type	Each	480
Sound System		
Amplifier, 250 watts	Each	2350
Speaker, ceiling or wall	Each	191
Trumpet	Each	365
TV Antenna, Master system, 12 outlet	Outlet	315
30 outlet	Outlet	203
100 outlet	Outlet	194

Model costs calculated for a 8 story building with 12' story height and 80,000 square feet of floor area

Office, 5-10 Story

Unit	Unit Cost	Cost Per S.F.	% Of Sub-Total
------	-----------	---------------	----------------

A. SUBSTRUCTURE

1010	Standard Foundations	Poured concrete; strip and spread footings	S.F. Ground	12.08	1.51	2.00 Assumed 2.1%
1020	Special Foundations	N/A	-	-		
1030	Slab on Grade	4" reinforced concrete with vapor barrier and granular base	S.F. Slab	4.74	.59	
2010	Basement Excavation	Site preparation for slab and trench for foundation wall and footing	S.F. Ground	.26	.03	
2020	Basement Walls	4' foundation wall	L.F. Wall	78	.53	

B. SHELL

B10 Superstructure

1010	Floor Construction	Concrete slab with metal deck and beams	S.F. Floor	26.25	22.97	19.0%
1020	Roof Construction	Metal deck, open web steel joists, interior columns	S.F. Roof	8.08	1.01	

B20 Exterior Enclosure

2010	Exterior Walls	Precast concrete panels	S.F. Wall	38.24	15.42	15.3%
2020	Exterior Windows	Vertical pivoted steel	Each	552	3.71	
2030	Exterior Doors	Double aluminum and glass doors and entrance with transoms	Each	3542	.22	

B30 Roofing

3010	Roof Coverings	Built-up tar and gravel with flashing; perlite/EPS composite insulation	S.F. Roof	5.52	.69	0.5%
3020	Roof Openings	N/A	-	-		

C. INTERIORS

1010	Partitions	Gypsum board on metal studs	S.F. Partition	9.09	3.03	19.2%
1020	Interior Doors	Single leaf hollow metal	Each	875	2.19	
1030	Fittings	Toilet Partitions	S.F. Floor	.73	.73	
2010	Stair Construction	Concrete filled metal pan	Flight	15,800	3.36	
3010	Wall Finishes	60% vinyl wall covering, 40% paint	S.F. Surface	1.35	.90	
3020	Floor Finishes	60% carpet, 30% vinyl composition tile, 10% ceramic tile	S.F. Floor	7.62	7.62	
3030	Ceiling Finishes	Mineral fiber tile on concealed zee bars	S.F. Ceiling	6.38	6.38	

D. SERVICES

D10 Conveying

1010	Elevators & Lifts	Four geared passenger elevators	Each	292,600	14.63	11.6%
1020	Escalators & Moving Walks	N/A	-	-		

D20 Plumbing

2010	Plumbing Fixtures	Toilet and service fixtures, supply and drainage	Each	2781	2.03	2.1%
2020	Domestic Water Distribution	Gas fired water heater	S.F. Floor	.42	.42	
2040	Rain Water Drainage	Roof drains	S.F. Roof	1.84	.23	

D30 HVAC

3010	Energy Supply	N/A	-	-	-	12.3%
3020	Heat Generating Systems	Included in D3050	-	-	-	
3030	Cooling Generating Systems	N/A	-	-	-	
3050	Terminal & Package Units	Multizone unit gas heating, electric cooling	S.F. Floor	15.50	15.50	
3090	Other HVAC Sys. & Equipment	N/A	-	-	-	

D40 Fire Protection

4010	Sprinklers	Wet pipe sprinkler system	S.F. Floor	2.33	2.33	2.7%
4020	Standpipes	Standpipes and hose systems	S.F. Floor	1.07	1.07	

D50 Electrical

5010	Electrical Service/Distribution	1600 ampere service, panel board and feeders	S.F. Floor	1.86	1.86	15.1%
5020	Lighting & Branch Wiring	High efficiency fluorescent fixtures, receptacles, switches, A.C. and misc. power	S.F. Floor	11.11	11.11	
5030	Communications & Security	Addressable alarm systems, internet and phone wiring, emergency lighting	S.F. Floor	5.05	5.05	
5090	Other Electrical Systems	Emergency generator, 100 kW, uninterruptible power supply	S.F. Floor	1.02	1.02	

E. EQUIPMENT & FURNISHINGS

1010	Commercial Equipment	N/A	-	-	-	0.0%
1020	Institutional Equipment	N/A	-	-	-	
1030	Vehicular Equipment	N/A	-	-	-	
1090	Other Equipment	N/A	-	-	-	

F. SPECIAL CONSTRUCTION

1020	Integrated Construction	N/A	-	-	-	0.0%
1040	Special Facilities	N/A	-	-	-	

G. BUILDING SITEWORK

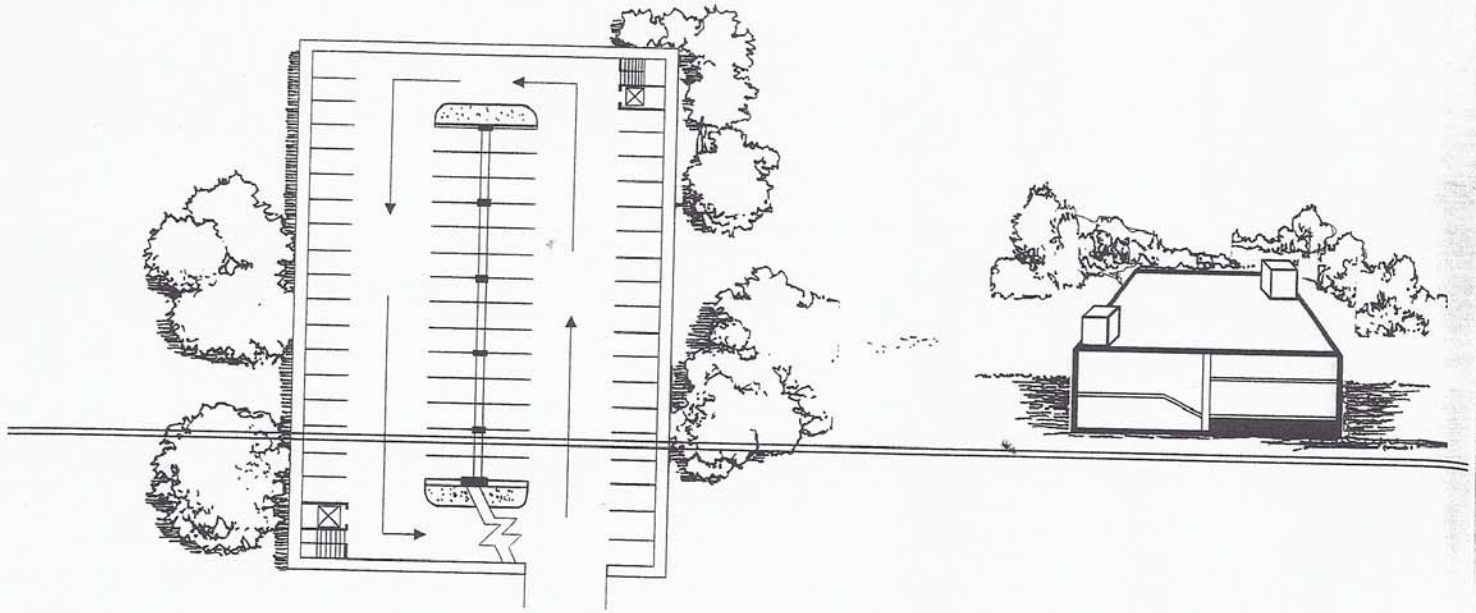
						Sub-Total	126.14	100%
CONTRACTOR FEES (General Requirements: 10%, Overhead: 5%, Profit: 10%)						25%	31.50	
ARCHITECT FEES						6%	9.46	

Total Building Cost 167.10

1000
00
8.55
3.95
6.45
2.20
5.20
0.55
1.90
1.05

Cost
650
169
470
187
480
350
191
365
315
203
194

Factors



Costs per square foot of floor area

Exterior Wall	S.F. Area	20000	30000	40000	50000	75000	100000	125000	150000	175000
	L.F. Perimeter	400	500	600	650	775	900	1000	1100	1185
Reinforced Concrete	R/Conc. Frame	93.55	87.50	84.45	81.60	77.70	75.80	74.35	73.50	72.75
Perimeter Adj., Add or Deduct	Per 100 L.F.	5.40	3.60	2.65	2.15	1.45	1.10	0.90	0.70	0.65
Story Hgt. Adj., Add or Deduct	Per 1 Ft.	2.05	1.65	1.55	1.30	1.05	0.85	0.90	0.75	0.70
Basement—Not Applicable										

The above costs were calculated using the basic specifications shown on the facing page. These costs should be adjusted where necessary for design alternatives and owner's requirements. Reported completed project costs, for this type of structure, range from \$46.60 to \$111.05 per S.F.

Common additives

Description	Unit	\$ Cost
Elevators, Hydraulic passenger, 2 stops		
1500# capacity	Each	62,800
2500# capacity	Each	66,300
3500# capacity	Each	69,800
Barrier gate w/programmable controller	Each	4000
Booth for attendant, average	Each	12,400
Fee computer	Each	15,000
Ticket splitter with time/date stamp	Each	7,450
Mag strip encoding	Each	21,000
Collection station, pay on foot	Each	126,000
Parking control software	Each	25,200 - 108,500
Painting, Parking stalls	Stall	13.25
Parking Barriers		
Timber with saddles, 4" x 4"	L.F.	7.10
Precast concrete, 6" x 10" x 6'	Each	81
Traffic Signs, directional, 12" x 18"	Each	84.50

Model costs calculated for a 2 story building with 10' story height and 100,000 square feet of floor area

Garage, Underground Parking

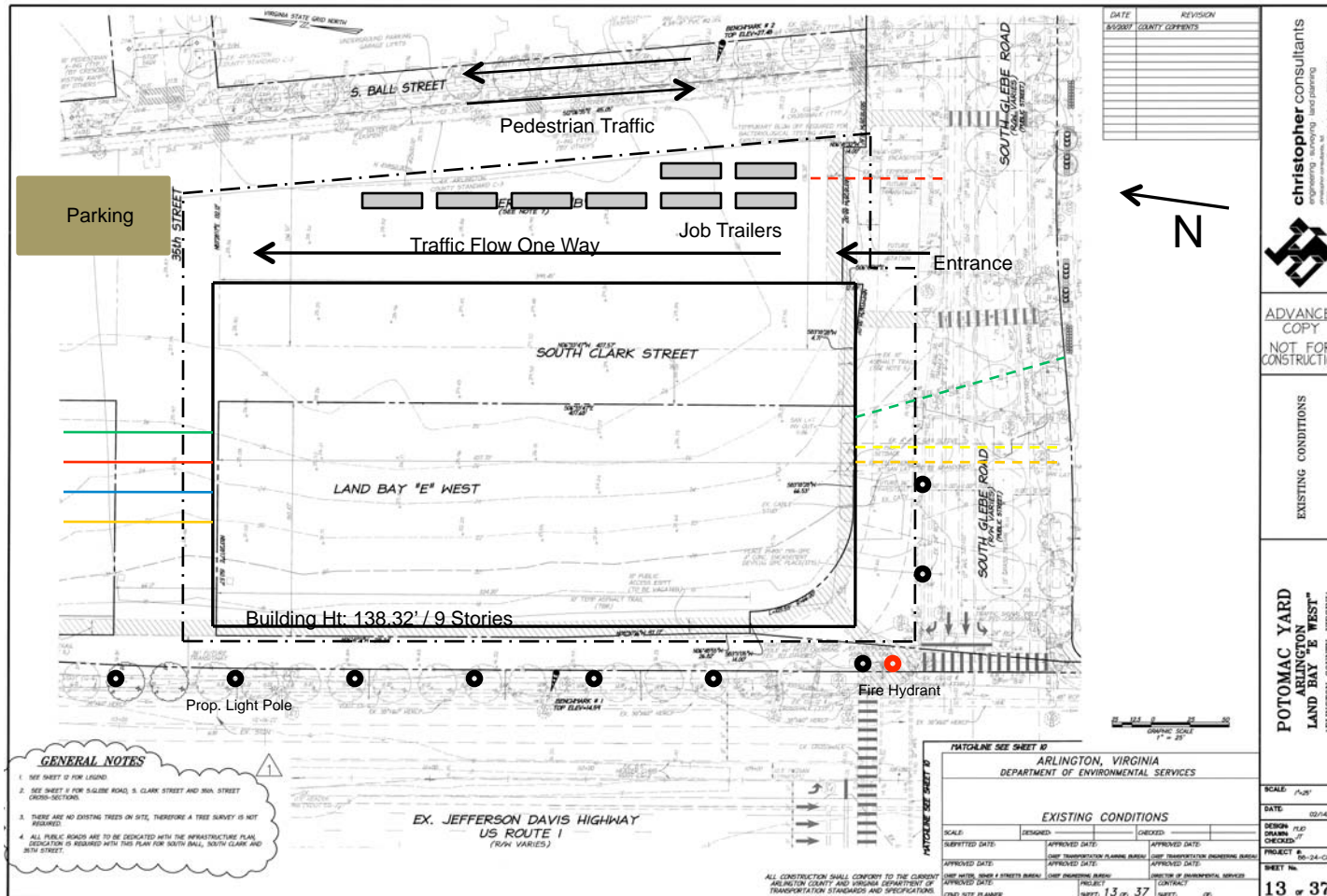
			Unit	Unit Cost	Cost Per S.F.	% Of Sub-Total
A. SUBSTRUCTURE						
1010	Standard Foundations	Poured concrete; strip and spread footings and waterproofing	S.F. Ground	7.86	3.93	
1020	Special Foundations	N/A	—	—	4.50	Assumed
1030	Slab on Grade	5" reinforced concrete with vapor barrier and granular base	S.F. Slab	6.27	3.14	20.4%
2010	Basement Excavation	Excavation 24' deep	S.F. Ground	8.80	4.40	
2020	Basement Walls	N/A	—	—	—	
B. SHELL						
B10 Superstructure						
1010	Floor Construction	Cast-in-place concrete beam and slab, concrete columns	S.F. Floor	28.40	14.20	
1020	Roof Construction	Cast-in-place concrete beam and slab, concrete columns	S.F. Roof	26.32	13.16	48.7%
B20 Exterior Enclosure						
2010	Exterior Walls	Cast-in place concrete	S.F. Wall	20.44	3.68	
2020	Exterior Windows	N/A	—	—	—	
2030	Exterior Doors	Steel overhead, hollow metal	Each	3965	.17	6.9%
B30 Roofing						
3010	Roof Coverings	Neoprene membrane traffic deck	S.F. Roof	4.22	2.11	
3020	Roof Openings	N/A	—	—	—	3.8%
C. INTERIORS						
1010	Partitions	Concrete block	S.F. Partition	38.48	.74	
1020	Interior Doors	Hollow metal	Each	7000	.07	
1030	Fittings	N/A	—	—	—	
2010	Stair Construction	Concrete	Flight	6400	.32	2.2%
3010	Wall Finishes	Paint	S.F. Surface	2.34	.09	
3020	Floor Finishes	N/A	—	—	—	
3030	Ceiling Finishes	N/A	—	—	—	
D. SERVICES						
D10 Conveying						
1010	Elevators & Lifts	Two hydraulic passenger elevators	Each	31,000	1.62	
1020	Escalators & Moving Walks	N/A	—	—	—	2.0%
D20 Plumbing						
2010	Plumbing Fixtures	Drainage in parking areas, toilets, & service fixtures	Each	.04	.04	
2020	Domestic Water Distribution	Electric water heater	S.F. Floor	.10	.10	2.0%
2040	Rain Water Drainage	Roof drains	S.F. Roof	2	1	
D30 HVAC						
3010	Energy Supply	N/A	—	—	—	
3020	Heat Generating Systems	N/A	—	—	—	
3030	Cooling Generating Systems	N/A	—	—	—	
3050	Terminal & Package Units	Exhaust fans	S.F. Floor	.15	.15	0.3%
3090	Other HVAC Sys. & Equipment	N/A	—	—	—	
D40 Fire Protection						
4010	Sprinklers	Dry pipe sprinkler system	S.F. Floor	3.33	3.33	
4020	Standpipes	Dry standpipe system, class 3	S.F. Floor	.13	.13	6.2%
D50 Electrical						
5010	Electrical Service/Distribution	200 ampere service, panel board and feeders	S.F. Floor	.13	.13	
5020	Lighting & Branch Wiring	T-8 fluorescent fixtures, receptacles, switches and misc. power	S.F. Floor	3.06	3.06	
5030	Communications & Security	Addressable alarm systems and emergency lighting	S.F. Floor	.14	.14	6.0%
5090	Other Electrical Systems	Emergency generator, 11.5 kW	S.F. Floor	.06	.06	
E. EQUIPMENT & FURNISHINGS						
1010	Commercial Equipment	N/A	—	—	—	
1020	Institutional Equipment	N/A	—	—	—	
1030	Vehicular Equipment	Ticket dispensers, booths, automatic gates	S.F. Floor	.36	.36	0.6%
1090	Other Equipment	N/A	—	—	—	
F. SPECIAL CONSTRUCTION						
1020	Integrated Construction	N/A	—	—	—	
1040	Special Facilities	N/A	—	—	—	0.0%
G. BUILDING SITEWORK						
		N/A	—	—	—	
				Sub-Total	56.13	100%
CONTRACTOR FEES (General Requirements: 10%, Overhead: 5%, Profit: 10%)				25%	14.06	
ARCHITECT FEES				8%	5.61	
Total Building Cost				75.80		

Location Factors

STATE/ZIP	CITY	Residential	Commercial
UTAH (CONT'd)			
845	Price	.70	.78
846-847	Provo	.80	.87
VERMONT			
050	White River Jct.	.76	.80
051	Bellows Falls	.78	.82
052	Bennington	.80	.83
053	Brattleboro	.80	.84
054	Burlington	.81	.86
056	Montpelier	.82	.84
057	Rutland	.81	.85
058	St. Johnsbury	.78	.80
059	Guildhall	.77	.79
VIRGINIA			
220-221	Fairfax	1.02	.93
222	Arlington	1.03	.93
223	Alexandria	1.07	.95
224-225	Fredericksburg	.94	.88
226	Winchester	.91	.86
227	Culpeper	.99	.88
228	Harrisonburg	.89	.86
229	Charlottesville	.90	.86
230-232	Richmond	.98	.88
233-235	Norfolk	1.00	.89
236	Newport News	.99	.88
237	Portsmouth	.92	.86
238	Petersburg	.96	.87
239	Farmville	.88	.81
240-241	Roanoke	.97	.85
242	Bristol	.85	.81
243	Pulaski	.83	.80
244	Staunton	.90	.84
245	Lynchburg	.95	.86
246	Grundy	.83	.80
WASHINGTON			
980-981,987	Seattle	1.02	1.04
982	Everett	1.04	1.02
983-984	Tacoma	1.02	1.03
985	Olympia	1.01	1.02
986	Vancouver	.97	1.01
988	Wenatchee	.92	.95
989	Yakima	.96	.98
990-992	Spokane	.99	.95
993	Richland	.97	.96
994	Clarkston	.96	.94
WEST VIRGINIA			
247-248	Bluefield	.88	.89
249	Lewisburg	.90	.92
250-253	Charleston	.95	.95
254	Martinsburg	.86	.90
255-257	Huntington	.96	.96
258-259	Beckley	.90	.93
260	Wheeling	.92	.96
261	Parkersburg	.91	.95
262	Buckhannon	.91	.95
263-264	Clarksburg	.91	.95
265	Morgantown	.92	.95
266	Gassaway	.91	.95
267	Romney	.89	.92
268	Petersburg	.91	.93
WISCONSIN			
530,532	Milwaukee	1.07	1.03
531	Kenosha	1.03	1.00
534	Racine	1.02	1.00
535	Beloit	.98	.97
537	Madison	.98	.98
538	Lancaster	.97	.94
539	Portage	.96	.95
540	New Richmond	.99	.95
541-543	Green Bay	1.00	.96
544	Wausau	.94	.92
545	Rhineland	.94	.94
546	La Crosse	.94	.94
547	Eau Claire	.97	.95
548	Superior	.98	.96
549	Oshkosh	.94	.93
WYOMING			
820	Cheyenne	.82	.86
821	Yellowstone Nat. Pk.	.74	.81
822	Wheatland	.74	.82

STATE/ZIP	CITY	Residential	Commercial
WYOMING (CONT'd)			
823	Rawlins	.75	.83
824	Worland	.74	.81
825	Riverton	.73	.81
826	Casper	.76	.83
827	Newcastle	.74	.81
828	Sheridan	.79	.84
829-831	Rock Springs	.78	.83
CANADIAN FACTORS (reflect Canadian currency)			
ALBERTA			
	Calgary	1.14	1.14
	Edmonton	1.13	1.14
	Fort McMurray	1.14	1.13
	Lethbridge	1.11	1.09
	Lloydminster	1.06	1.05
	Medicine Hat	1.07	1.05
	Red Deer	1.07	1.05
BRITISH COLUMBIA			
	Kamloops	1.05	1.06
	Prince George	1.05	1.07
	Vancouver	1.06	1.11
	Victoria	.99	1.02
MANITOBA			
	Brandon	1.02	1.00
	Portage la Prairie	1.02	.99
	Winnipeg	1.02	1.04
NEW BRUNSWICK			
	Bathurst	.94	.95
	Dalhousie	.94	.95
	Fredericton	1.01	.98
	Moncton	.95	.96
	Newcastle	.94	.95
	St. John	1.01	.98
NEWFOUNDLAND			
	Corner Brook	.96	.98
	St. Johns	.98	.99
NORTHWEST TERRITORIES			
	Yellowknife	1.07	1.06
NOVA SCOTIA			
	Bridgewater	.97	.99
	Dartmouth	.98	1.00
	Halifax	1.00	1.02
	New Glasgow	.97	.99
	Sydney	.96	.97
	Truro	.97	.99
	Yarmouth	.97	.99
ONTARIO			
	Barrie	1.13	1.08
	Brantford	1.14	1.09
	Cornwall	1.14	1.08
	Hamilton	1.16	1.12
	Kingston	1.14	1.09
	Kitchener	1.09	1.05
	London	1.14	1.10
	North Bay	1.11	1.07
	Oshawa	1.13	1.08
	Ottawa	1.16	1.11
	Owen Sound	1.11	1.08
	Peterborough	1.12	1.08
	Sarnia	1.14	1.09
	Sault Ste Marie	1.07	1.04
	St. Catharines	1.10	1.05
	Sudbury	1.07	1.04
	Thunder Bay	1.12	1.05
	Timmins	1.11	1.07
	Toronto	1.17	1.14
	Windsor	1.11	1.05
PRINCE EDWARD ISLAND			
	Charlottetown	.92	.95
	Summerside	.92	.95
QUEBEC			
	Cap-de-la-Madeleine	1.13	1.04
	Charlesbourg	1.13	1.04
	Chicoutimi	1.16	1.05
	Gatineau	1.12	1.03

Appendix D: Site Plan of Existing Conditions



GENERAL NOTES

- SEE SHEET D FOR LEGEND
- SEE SHEET D FOR BUILDING ROAD, S. CLARK STREET AND S.W. STREET CROSS-SECTIONS
- THERE ARE NO EXISTING TREES ON SITE, THEREFORE A TREE SURVEY IS NOT REQUIRED
- ALL PUBLIC ROADS ARE TO BE DEDICATED WITH THE INFRASTRUCTURE PLAN. DEDICATION IS REQUIRED WITH THIS PLAN FOR SOUTH MALL, SOUTH CLARK AND S.W. STREET

EX. JEFFERSON DAVIS HIGHWAY
US ROUTE 1
(R/W VARIES)

ALL CONSTRUCTION SHALL CONFORM TO THE CURRENT ARLINGTON COUNTY AND VIRGINIA DEPARTMENT OF TRANSPORTATION STANDARDS AND SPECIFICATIONS

DATE	REVISION

christopher consultants
engineering · surveying · land planning
10000 Lees Ferry Road, Suite 1000
Arlington, VA 22204
703.241.6000 Fax 703.241.6001



ADVANCE COPY
NOT FOR CONSTRUCTION

EXISTING CONDITIONS

POTOMAC YARD
ARLINGTON
LAND BAY "E" WEST"
ARLINGTON COUNTY, VIRGINIA

PATCHLINE SEE SHEET D			
ARLINGTON, VIRGINIA DEPARTMENT OF ENVIRONMENTAL SERVICES			
EXISTING CONDITIONS			
SCALE: 1/8"=1'-0"	DESIGNED: []	CHECKED: []	DATE: 02/14/07
SUBMITTED DATE: []	APPROVED DATE: []	DESIGN CHECKED: []	DESIGN CHECKED: []
APPROVED DATE: []	DESIGN ENGINEERING BOARD: []	APPROVED DATE: []	PROJECT # 05-24-0A.03
APPROVED DATE: []	PROJECT: []	CONTRACT: []	SHEET # 13 of 37
DATE: 10/05/09			

- Building Perimeter w/ Parking
- - - - Property Line & Construction Fence
- - - - Exist. Sanitary
- - - - Exist. Communication
- - - - Exist. Gas
- - - - Sanitary
- - - - Electric
- - - - Gas
- - - - Water
- - - - Temp. Electric

Potomac Yard
Land Bay E

Existing
Conditions

Drew Heilman

10/05/09