

PENN STATE AE SENIOR THESIS 2011 - 2012

TECHNICAL ASSIGNMENT 1

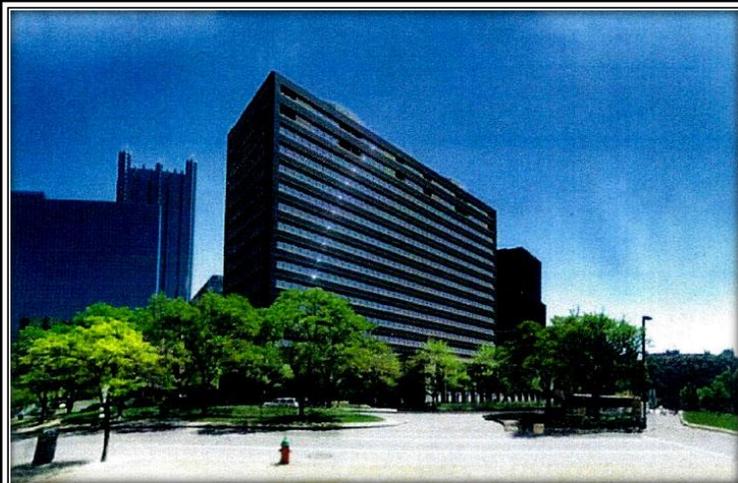
Construction Project Management

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RIVER VUE APARTMENTS | NEW LUXURY APARTMENTS RENOVATION | PITTSBURGH, PA



Executive Summary

Technical Assignment 1 is intended to analyze the background information of the River Vue Apartments building including the conditions under which the building is constructed and the scope of work. The background knowledge presents the opportunities and constraints that affect the design and construction process. River Vue Apartments is the innovative reuse of the former Commonwealth of Pennsylvania State Office Building located in Pittsburgh, PA. Across from Point State Park in the Golden Triangle, these new luxury apartments will offer some of the best views of the city to its residents. The existing building was constructed in the 1950s, and through its simplicity and clarity of its form, it reflects a more modern architectural style. The construction project is a 295,000 SF renovation of the 16 story building. New additions, to transition from an office building to a residential building, include 218 apartment units, a two-story interior valet-parking garage on the basement and first floors, a small retail space of approximately 1,900 SF, a building party / media room, and a small fitness center.

Information about the schedule of the design, procurement, and construction phases is discussed in the assignment with a summarized project schedule. The beginning construction date is June 13, 2011, and the final completion date is October 3, 2012. A very detailed look at the building systems includes the analysis of the existing steel frame structure, new private exterior inboard balconies on the top two floors, and all new mechanical, electrical, and plumbing systems. Also, the methods of construction and the sustainability design features to achieve LEED Certification are analyzed in this section of the assignment. Using RS Means CostWorks Square Foot Estimating software and the RS Means Assemblies Cost Data 2010 edition, the project cost was compared to the actual total building construction cost (\$23,362,182) and the MEP/FP costs (\$10,505,166) provided by the general contractor, Turner Construction Company. The comparison demonstrated the complexity of the building and the major differences between the two forms of estimating.

After developing and analyzing the existing conditions, excavation phase of construction, demolition phase of construction, and the MEP/Finishes site plans, it was evident that site logistics plans are very useful to the general contractor when the construction of the project changes for the worse. During these changes, if the plans are lacking information or detail, it can cause confusion and frustration in the construction. In addition, the existing conditions site plan and the local condition summary analyzed the existing utilities and the preferred methods of construction in the Pittsburgh area. Finally, a detailed analysis of the client's (River Vue Associates, LP) quality, schedule, cost, and safety expectations for the project, the project delivery system, and the contract types were analyzed. Since the River Vue Apartments renovation's complexities lie in demolition, abatement of asbestos, and installation of new building systems, it is very important to have a general contractor that is experienced in the construction industry. For Turner Construction Company, the key to successfully completing the project to the owner's satisfaction is to execute River Vue Associates' quality, schedule, cost, and safety expectations and to keep them in mind as the main priority.



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Project Summary Schedule

**See Appendix A for the Project Summary Schedule*

Preconstruction

After reviewing the submitted proposals and meeting with the proposing design teams, River Vue Associates, LP (RVA) determined that Design 4 Studio, Inc. and Intelligent Design Group, LLP (IDG) were the most qualified firms to design the new River Vue Apartments. The two architectural firms developed a joint venture. On February 10, 2010, the architects were authorized to begin design activities with RVA's management team. Official work on the schematic design started on February 15, 2010 and design development started on April 4, 2010. After the construction documents were completed on July 9, 2010, RVA approved the design and construction documents. Then, they proceeded to the procurement phase.

Procurement

On July 9, 2010, River Vue Associates announced the River Vue Apartments project to bid for general construction services. They held a mandatory pre-bid meeting and offered an optional pre-bid walk-thru of the project. By 2:00 PM on July 30, 2010, the general construction bid was due to RVA. After reviewing the submitted proposals, RVA awarded the project to Turner Construction Company's Pittsburgh office on September 9, 2010.

Construction

A detailed construction plan and sequence was utilized for the River Vue Apartments project to ensure timely project completion. For the construction phase, the project schedule's tasks are the main tasks that reflect the site work, structural system, roofing system, glazing, abatement and demolition, interiors, rough-in and finishes, occupancy, and completion. On June 13, 2011, official work on the construction phase began. The beginning stages of the construction phase include the demolition of all the existing walls and systems and asbestos abatement.

Once demolition and asbestos abatement is complete, the element that remains is the structural system of the building. With the structural system of the building remaining, the construction of the basement and first floors parking garages begins. During this construction sequence, the site work for the new parking garage ramps on the east side of the building is completed. Also, new utility lines are constructed as well as a new patio on the North side of the building.

In addition to the site work occurring during the construction of the parking garages, the 218 apartment units are constructed starting on the second floor and moving up to the sixteenth floor. The building is turned over to the owner in two phases. Ground-5 will be available in April 2012, and the entire building will be turned over by October 2012.



Building Systems Summary

Table 1: Building Systems Checklist

Building Systems Checklist		
Yes	No	Work Scope
✓		Demolition
✓		Abatement
✓		Structural Steel Frame
✓		Cast-in-Place Concrete
	✓	Precast Concrete
✓		Mechanical System
✓		Electrical
✓		Masonry
✓		Curtain Wall
✓		Support of Excavation
✓		Sustainability Features

Demolition

Before the construction process of the new River Vue Apartments building can begin, demolition throughout the whole existing building needs to be completed. There are several building elements and materials that need to be removed. These elements and materials include the existing interior walls to accommodate the new layout, walls that are flush with existing adjacent surfaces, floor materials including adhesives and tack strips, doors, door frames, door hardware, ceiling tile, gypsum-board bulkheads and ceilings, and light fixtures. A view of the interior demolition is shown in Figure 1.



Figure 1: Interior Demolition on 1st Floor

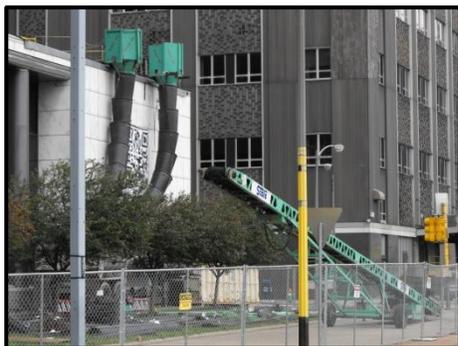


Figure 2: Lower Roofing System Demolition

Also, more elements and materials include casework, toilet partitions, three existing elevators, existing stairs, and railings. All of the mechanical, electrical, plumbing, fire protection, roofing, and window systems' elements are to be demolished as well because new systems are going to be installed. A view of the lower roofing system demolition is shown in Figure 2. In addition, since the existing structure is the only element that will remain, if it is required during demolition, shoring and bracing are to be provided to prevent any displacement of structural elements, shifting, or collapse. After the removal of



these materials and building elements, the disturbed areas must be repaired. The disturbed floors, walls, and ceilings must be repaired with finishes to match existing adjacent. Paint or any finishing adjacent surfaces must eliminate any and all visible evidence of modification during the demolition process.

Environmental Hazards Abatement

Hazardous Material consultant L. Robert Kimball and Associates, Inc. (L.R. Kimball) determined all of the asbestos containing materials and other environmental hazards existing within the building. The other environmental hazardous materials consist of mercury containing fluorescent lamps thermostats, thermometers and switches, chlorofluorocarbons in refrigerator/HVAC units, electronic equipment, lead based paints, oils, and lubricants. The following table, Table 2, shows the total quantities of asbestos containing materials throughout the entire former Pennsylvania State Office Building.

Table 2: Total Quantities of Asbestos Containing Materials throughout Entire Existing Building

Total Quantities of Asbestos Containing Materials	
Asbestos Containing Material	Approximate Quantity
Pipe Insulation and Associated Mudded Fittings	9,430 LF
Tank Insulation	700 SF
Duct Insulation	4,450 SF
Ceiling Plaster	3,400 SF
Drywall and Joint Compound	6,000 SF
Transite Ceiling Panels	4,200 SF
9" x 9" Floor Tile and Mastic	130,250 SF
12" x 12" Floor Tile and Mastic	10,670 SF
Floor Tile Mastic Below Carpeting	16,100 SF
Metal Wall and Column Panel Sound Proofing	93,300 SF
Stored Elevator Switch Gear Insulators	2 SF
Elevator Door Insulation	196 Doors
Elevator Electrical Equipment (insulators, wire insulation, and transite spacers)	14 Units
Main Electrical Units	2 Units

It is extremely important to correctly remove and dispose of these hazardous materials. For example, if these materials are not removed and disposed of correctly, during renovation, they can release airborne asbestos fibers into the air. These fibers can cause harm to the labor workers in the building or to future tenants in the River Vue Apartments building.



Structural Steel Frame

Once demolition and asbestos abatement is complete, the existing structure of the building is the main building component preserved and reused for the renovation of the new River Vue Apartments. Therefore, this section of the technical assignment will analyze the existing structural steel frame system and new additions to the structural system.

Existing Structural Steel Frame System: The existing structure of the building is composed of a steel superstructure with concrete floor slabs. In detail, the typical structural steel column sizes used throughout the building are W8s, W10s, and W14s with the weight ranging from 43 lbs/ft to 264 lb/ft. For the structural steel beam sizes, the typical sizes are W8s, W10s, W12s, W14s, and W16s with ranging weights. Also, W24s and W30s are the steel beams that are part of the roofing system. With ASTM A992 steel specifications, the W shaped beams and columns are designed to have the yield strength of $FY = 50 \text{ kips/in}^2$.

Concrete Floor Slab Breakdown: For the existing second floor, the existing concrete slab system is $5 \frac{5}{8}$ " thick. Low roof construction consists of $1 \frac{1}{2}$ "x20 GA wide rib galvanized Type B roof deck. In addition, for the existing third through fourteenth floors, the existing concrete slab system is $5 \frac{5}{8}$ " thick.

For the fifteenth floor, the existing concrete slab system is $5 \frac{5}{8}$ " thick. Also, to accommodate for the new balcony slab, the existing slab on deck will be removed and replaced with the new $5 \frac{5}{8}$ " normal weight concrete slab with $1 \frac{1}{2}$ "x20 GA composite deck. For the sixteenth floor, the existing concrete slab system is $5 \frac{5}{8}$ " thick, and the new stair system will include hangers. After cutting the existing steel required, full "T" double shear connections will be applied to the new steel. Also, to accommodate for the new balcony slab, the existing slab on deck will be removed and replaced with the new $5 \frac{5}{8}$ " normal weight concrete slab with $1 \frac{1}{2}$ "x20 GA composite deck.

New Structural Steel Additions: The additions to the structure are the new bracing steel frames and the in-fills needed at the existing elevator shafts that will not be used for building transportation purposes. The new brace frames, shown in Figures 3 and 4, will consist of W17x21.5s for each set between the different column lines. One brace frame will connect two columns that are 10 ft apart, and the other braced frame will connect two columns that are 26 ft apart. Each braced steel frame will be attached together in the middle with a required $\frac{1}{2}$ " filler plate, and they will be connected to the columns with four $\frac{1}{2}$ " gusset plates.

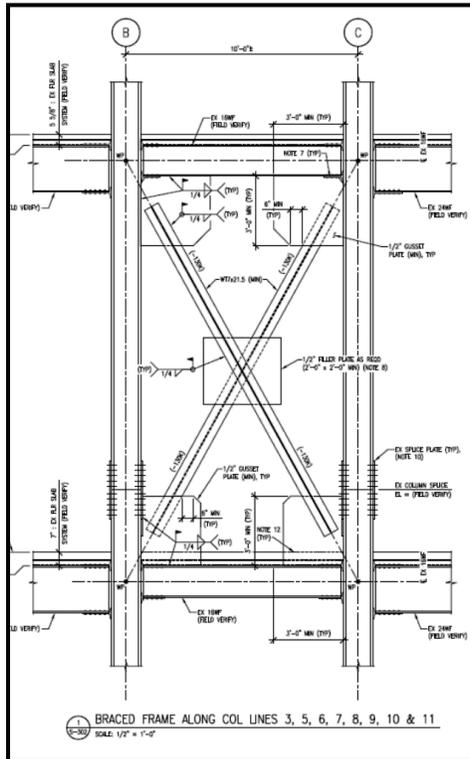


Figure 3: Braced Frame between Column Lines B & C

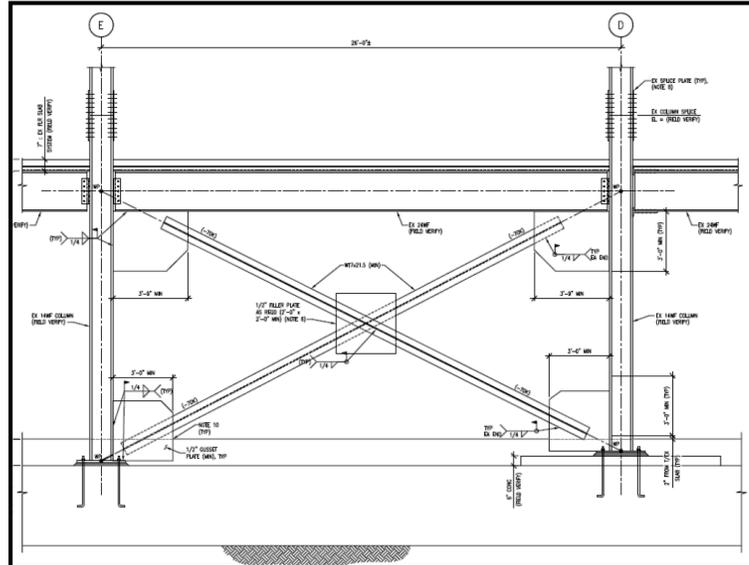


Figure 4: Braced Frame between Column Lines E & D

In addition, shown in Figures 5 and 6, two of the former elevator shafts will be used for mechanical and electrical routing and another elevator will be in-filled with concrete. Therefore, steel will be needed for this additional load. In the elevator lobby area, all new steel beams to support the concrete in-fill are W8x17s and designed to have the yield strength of $FY = 50 \text{ kips/in}^2$.

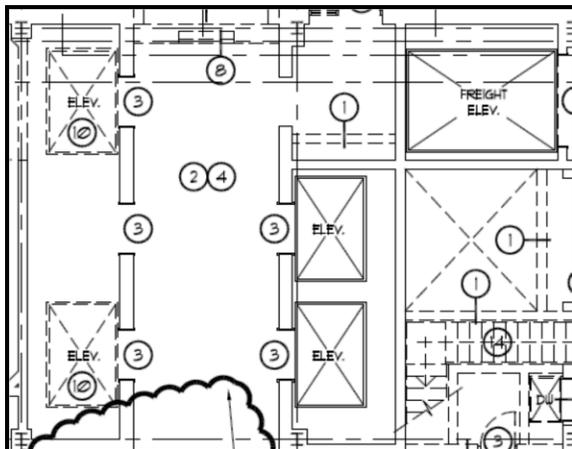


Figure 5: Elevator Lobby before Demolition, AD-101

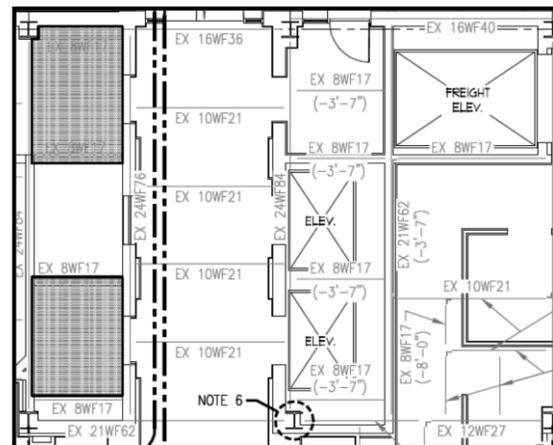


Figure 6: Elevator Lobby after Demolition, S-101



Crane Details: For the River Vue Apartments renovation project, numerous hydraulic truck cranes will be utilized throughout the duration of the project for new additional steel placement and for other aspects of the construction as well. The cranes will be brought in on an as-needed basis for one-day operations, and they will be placed on the east or west sides of the building to complete the operations. These operations include removing the old chillers from the basement, installing the new steam vault at the north end of the site, moving any rooftop equipment to the roof, and placing any large equipment that might be installed on the upper floors.

Since the size and model of the cranes used on the site is based on the lifted materials' weights and lifting locations, this section of the technical assignment will discuss the assumed crane size and model that reflects the given information. All of the crane information below was found on Manitowoc Cranes' official website ("Grove Products" et al.).

Crane Type: Hydraulic Truck Crane
Crane Model: Manitowoc Grove GMK4100B
Capacity: 100 US TON
Main Boom: 167 FT
Max Tip Height: 248 FT
Gross Vehicle Weight: 88,750 LBS

For crane operations, this crane was assumed to be the type of crane used on the River Vue Apartments site because it reflects the given project information. For instance, the max tip height extends over the existing building's height (211.5 ft)s by 36.5 ft, and the capacity can lift the largest steel beams used on the project (W24s and W30s). In addition, the hydraulic truck crane is very versatile, and they require minimal assembly and can be used for economical and efficient lifting for medium capacity projects ("Grove Products" et al.).

Cast-in-Place Concrete

Cast-in-place concrete will be used for two main parts of the new renovation. The first main part is the new basement and first floors garage ramps located on the east side of the building. Since this concrete is exposed, paneled formwork will be used to ensure continuous and smooth forms. The elevators' concrete in-fills require cast-in-place concrete as well. Wood or metal formwork can be used for this placement of concrete because the concrete will be unexposed. For these parts of the construction, the formwork must be designed and constructed to maintain its form and to be used within its tolerance limits outlined in ACI 301-05. Also, the concrete will be placed using a concrete truck and pump. Therefore, the formwork must be able to accommodate the pressure exerted by the pump. Otherwise, the formwork will shatter and become useless.



Mechanical System

Heating, Ventilation, and Air Conditioning (HVAC): The existing mechanical system components, such as chilled and hot water supply and return piping, will be demolished and replaced. The new main heating components will include: A/C unit, cooling coils, controls, drains, piping, return air grilles, and all other equipment required. Also, an exhaust fan, flex connections, hanging rods, vibration isolators, ductwork, and all other associated items will be required. Loop water supply and return piping, hangers, insulation, dampers, and valves are required in this system as well. All these components will be routed with new and existing conditions of all trades. To heat the water for the building, two 200 GPM boilers will be installed with connect to the pumps that will distribute the water to the various spaces, especially the 218 apartment units. Each apartment unit is handled by an individual heat pump. Also, a 1024 GPM plate heat exchanger will collect residual heat and conserve energy for the mechanical system.

For the entire mechanical system of the building, the major component is the single 26,300 CFM air-handling unit located on the roof. Hidden behind three new curved and perforated stainless steel panels, the unit will serve two supply risers and two exhaust risers. Also, it will be feeding the mechanical chase located to the East of the unit. In one of the former elevator shafts, this chase will run all the way through the building. From the chase, it will break out and feed each floor's main corridor.

Plumbing: For the plumbing system, the piping will serve all aspects, such as showers, kitchen sinks, water closets, and lavatories, below each floor unless otherwise noted. Located on the roof, a 350 ton cooling tower will serve the plumbing system's riser. Also, the new main plumbing components required include water closets, ½" hot and ¾" cold water piping, vent piping, electric water heaters, mixing valves, an expansion tank, and sanitary piping.

Fire Protection: Located at the northwest corner of the building, the fire service entrance will serve the building from one standpipe (Stair A). Each floor will be fully installed with dry sprinklers spaced evenly throughout the spaces. The pressure of the dry-pipe system will be maintained from the fire pump located in the fire pump room on the basement floor. Also, 6" dry standpipes will be installed in each stairwell, and fire alarms connected to the emergency power system will be placed throughout the building.

Electrical System

During the first phase of construction for the project, all of the existing electrical work will be demolished. However, the existing 300kW generator and emergency diesel generator will remain in their current location on the basement floor. These power feeders will be used for temporary power during the construction phases. In addition, the electrical system will operate on a three-phase 120/208V system, powered by the main electrical room on the basement floor. Electrical power will be brought into the building's 2000A switchboard by Duquense Light Company at a voltage of 208V from a ground bus duct located on the north side of the building. After serving the 100A, 225A, and 400A



panel boards, the service will split for house power and tenant service. Then, the power will be distributed up through the building to serve each apartment unit.

Also, more functions of the system include: a non-fused disconnect switch for the hydraulic lift system pump, power to the motorized door, continuing bus duct and conduit to the floors above and below each floor, and power to the sprinkler-head trace.

Masonry

Masonry, particularly concrete masonry units (CMUs), is used for new and existing wall construction in the River Vue Apartments building. Discussed further in the curtain wall system section, the existing façade's dark metal and marble panels are backed by 8" CMUs for architectural purposes because they are not load bearing masonry walls. 8" CMU is used to re-support the existing elevator shaft wall as well. Also, new 12" CMUs are used in the lobby area of the apartment building, and they are load bearing. The loading bearing type for the walls corresponds with ASTM C 90. The normal weight concrete masonry units must have a minimum average net-area comprehensive stress of 2800 psi, and must be manufactured to dimensions 3/8" less than the nominal dimensions. In addition, if necessary, free standing scaffolding will be used for the construction of the new masonry walls.

Curtain Wall System

Dark metal panels, marble panels, and glazing are the main components incorporated into the existing building's facade. The 2" thick marble panels on the first and second floors and the 1-1/4' thick aluminum panels covering the rest of the building, shown in Figure 7, are supported by existing 8" CMUs, existing continuous vertical steel tees, and insulated by 2" rigid insulation. Varying window sizes create the new glass window system with 1" thick tempered glass. Each window size is required for a specific number of units: 3'-9" x 5'-6" for 13 units, 3'-9" x 8'-2" for 2 units, 3'-9" x 4'-2" for 3 units, 4'-2" x 5'-6" for 4 units, and (4) 3'-8" x 8'-2" for 20 units. The new glass bronze-colored window systems is insulated and installed to match the existing window system. The architects were responsible for the window system change. Since the existing dark-tinted windows matched the dark paneled architectural features of the building, they wanted to lighten the tint of the windows. They believed this would bring more natural daylighting into the apartment units and lighten the dark exterior architectural features.



Figure 7: View of Curtin Wall



Support of Excavation



Figure 8: View of Timber Shoring System

The excavation support system used for the River Vue Apartments project is a temporary timber shoring system. This system minimizes the excavation area, keeps the sides of the excavation stable by preventing the movement of soil, and protects underground utilities. Also, during the excavation phase of construction, it is used to maintain safety of workers and other on-site personnel.

Sustainability Features

River Vue Associates and all the members of the project team determined the overall project goal is to achieve a LEED certified rating on the River Vue Apartments project. There are several main design aspects that contribute to the sustainable features of the building. Design features that contribute to the LEED Certification goal include the white-colored EPDM rubber membrane used for the roofing system that will minimize the amount of heat absorbed by the material. Also, the thermally insulated glazing for the new window system will reduce the amount of heat gain within the building from natural daylighting.



Project Cost Evaluation

Project Parameters

Total Building Square Footage = 295,000 SF

Building Perimeter = 397 LF

Actual Building Construction Cost

For the actual building construction cost, several line items were excluded. These line items include:

- Earthwork = \$360,346
- General Requirements/Indirects = \$2,304,344
- Lawns and Planting = \$53,555
- Roads and Walkways = \$59,976
- Special Construction (Demolition/Abatement) = \$2,108,507

All the cost per square foot information is derived from the total renovation project size of 295,000 SF. Also, the costs are based on the final estimated values produced and provided by Turner Construction Company.

Total Building Construction Cost = \$23,362,182

Building Construction Cost Per Square Foot = \$79.19/SF

Total Project Cost

The total project cost includes all line items.

Total Project Cost = \$28,248,910

Project Cost Per Square Foot = \$95.76/SF



Major Building Systems Costs

Actual Building Systems Costs		
System	Total Cost	Cost Per Square Foot
Concrete	\$800,854	\$2.71/SF
Masonry	\$153,268	\$0.52/SF
Steel/Metals	\$1,106,064	\$3.75/SF
Mechanical	\$3,138,415	\$10.64/SF
Electrical	\$3,754,401	\$12.73/SF
Plumbing/Fire Protection	\$3,612,350	\$12.25/SF

Table 3: Major Building Systems Costs

Square Foot R.S. Means Estimate

***See Appendix B for RS Means Cost Works 2010 Reports**

The information given from the RS Means CostWorks 2010 reports does not include site work, contingencies, allowances, fees, etc. Therefore, the building construction cost will be the total.

Total Building Construction Cost = \$40,492,000

Building Construction Cost Per Square Foot = \$137.26

RS Means CostWorks Building Systems Costs		
System	Total Cost	Cost Per Square Foot
Substructure	\$4,443,000	\$15.06
Shell	\$7,997,500	\$27.11
Interiors	\$9,596,000	\$32.53
Services	\$17,448,000	\$59.15
Equipment & Furnishings	\$1,007,500	\$3.42

Table 4: Building Systems Costs Produced by RS Means CostWorks 2010

Assumptions:

- For building type estimating purposes, used face brick with concrete block back-up and steel frame because the dark metal and marble panels are backed with 8" CMU and the frame is structural steel.
- Labor type – Standard Union, Year 2010 Quarter 1



Assemblies Cost Estimates for the MEP Systems

****See Appendix C for Assemblies Cost Estimates for the MEP Systems***

Total MEP Systems Assemblies Cost = \$10,059,055.78

Mechanical:

Mechanical Subtotal = \$2,667,188

Assumptions:

- Used RS Means Assemblies Cost Data 2010 edition
- Assumed window and door systems to be passive solar
- Assumed HVAC system included a water cooled unit and an air cooled unit

Electrical:

Electrical Subtotal = \$2,575,503.43

Assumptions:

- Used RS Means Assemblies Cost Data 2010 edition
- Used gross square footage for wall switches and central air conditioning power
- Assumed one switchgear and service installation.

Plumbing:

Plumbing Subtotal = \$4,626,812.15

Fire Protection Subtotal = \$189,552.20

Assumptions:

- Used RS Means Assemblies Cost Data 2010 edition
- Assumed standpipe is on every floor in every stairwell
- Assumed four fire extinguishers on each apartment floor
- Assumed an electric water heater and a water cooler are in each apartment unit



Comparison of Estimates versus Actual Project Costs

RS Means Cost Works: To compare the RS Means square foot estimate to the estimate provided by Turner Construction Company, the actual construction cost of the building must be analyzed. The total project cost cannot be analyzed because the RS Means square foot estimate does not include site work, contingencies, allowances, or fees. The RS Means is approximately \$17,129,818 over the actual construction cost of River Vue Apartments. Since the project is a renovation project, the substructure, shell, and elevators are already part of the existing structure. If those costs were taken out of the total building construction cost, the new total would be \$23,930,000. This value is much closer to the actual building construction cost (\$23,362,182). RS Means CostWorks does not have a renovation estimate option; therefore, the new construction option had to be used to complete the square-foot estimate. If a rough estimate is needed for proposing a budget, then, the RS Means Cost Works software is a useful tool. However, for detailed square-foot estimating, it does not take into consideration the assumptions or detail needed for certain aspects of a building.

MEP Assemblies Cost: By using the RS Means Assemblies Cost Data 2010 edition from RS Means Cost Works, the estimate developed was considerably less than the estimate provided by Turner Construction Company. For the mechanical system and its components, the estimated value was \$2,667,188, and it was \$471,227 less than the provided value (\$3,138,415). For the electrical system, the estimated value was \$2,575,503.43, and it was \$1,178,897.57 less than the provided value (\$3,754,401). For the plumbing system, the estimated value was \$4,626,814.5, and it was \$1,014,464.5 more than the provided estimate (\$3,612,350). Finally, the fire protection estimate's estimated value was \$189,552.20, and it was \$3,422,797.8 less than the provided estimate (\$3,612,350). However, in the general contractor's estimate, the plumbing and fire protection costs are combined. The total estimated combined cost of the MEP/FP systems was \$10,059,055.78, which is \$446,110.22 less than the actual cost (\$10,505,166). After analyzing the results, there are a few main reasons why these estimates are so different. The reasons include personal human error, false assumptions, and the lack of understanding the new mechanical, electrical, plumbing, and fire protections systems and their components. In addition, even though the MEP/FP systems are new, some of the older equipment is still being preserved and used in the new building such as the 300kW generator and emergency diesel generator.



Existing Conditions Site Plan Summary

**See Appendix D for the Existing Conditions Site Layout Plan*

The site of River Vue Apartments is located in the Golden Triangle of the city of Pittsburgh, across from Point State Park. The aerial image below, Figure 9, shows the location of the River Vue Apartments project circled in white. Sitting on the corner lot, the site for the River Vue Apartments project is located next to and across from several existing structures. The Pittsburgh Post-Gazette building (1), the Wyndam Grand Pittsburgh Downtown Hotel (2), and the Gateway Center Parking Garage (3) are just a few of the structures located near the project.

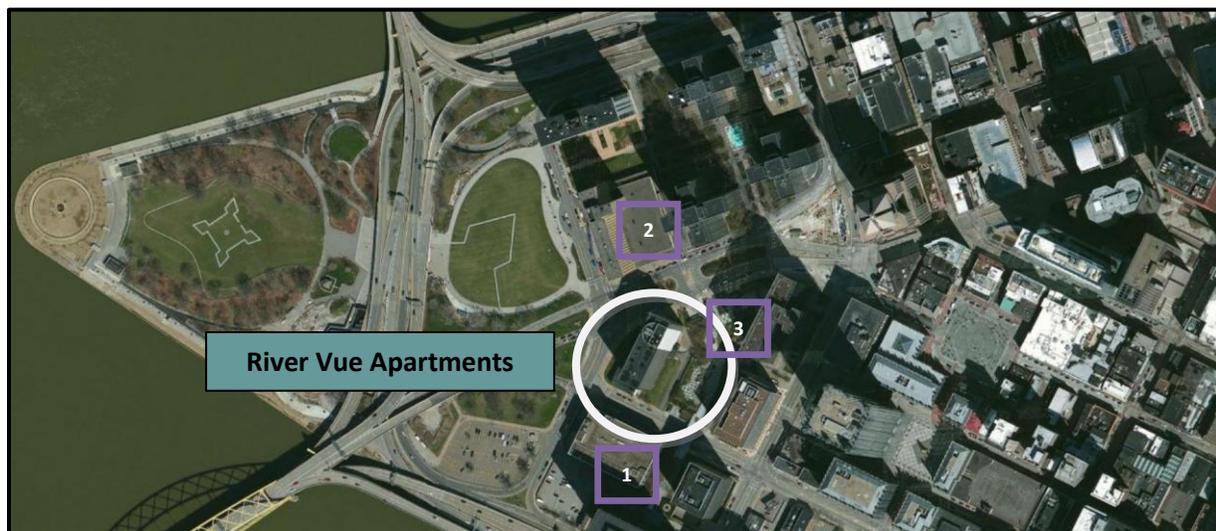


Figure 9 – Aerial View of Project Location from Flash Earth

Since it is located in an urban area, the River Vue Apartments' construction site is limited on space. Therefore, no parking is available on the site. Project personnel and labor workers are able to park in the Gateway Center Parking Garage or in any other parking garages and parking areas located throughout the city. In addition, the one main issue with the project's site is that it is located in the Golden Triangle at 300 Liberty Avenue, which has some of the heaviest vehicular and pedestrian traffic. Shown on the Existing Conditions Site Plan in Appendix D, public pedestrian traffic is the main concern because two sections of the sidewalk around the perimeter of the construction site are closed off to the public. The closing of the sidewalks is to ensure that all pedestrians are safe when commuting past and around the outside of the site. Also, regular public vehicular traffic is not a main concern. However, the metered parking spaces on the south side of the building are closed as well due to construction site access and deliveries.



Site Layout Planning Summary

**See Appendix E for the Site Plan for Excavation Phase of Construction*

Excavation Phase of Construction

For the excavation phase of construction, the project has a lot of excavation work going on, and the site is limited on space around the excavation areas. Excavation work for the basement and first floors parking garage ramps is the largest and main area of excavation. During the excavation phase, some of the key features on the site plan include the construction fence that marks the construction site location, closed-off metered parking spaces and public sidewalks, gravel and soil stock piles, dumpsters, four temporary toilers, and the timber shoring support excavation system. Also, since it is a renovation project, Turner Construction Company is using a section of the building on the northeast side for their field offices.

Demolition Phase of Construction

**See Appendix F for the Site Plan for Demolition Phase of Construction*

For the demolition phase of construction, the more dumpsters and material lay down areas are on the site. Also, a hydraulic truck crane with a boom length of 167 ft is located on the east side of the site near the existing loading dock. However, the crane can be placed anywhere on the east and west sides of the building. During demolition, the crane is used to remove the old chillers from the basement floor, and any rooftop equipment from the roof. In addition, the interior features of the building are used for material storage, and one of the existing elevators is used for a trash chute. For the River Vue Apartments project, major transportation equipment such as personnel and material hoists are not needed because of the existing operable elevators inside the building.

MEP/Finishes Phase of Construction

**See Appendix G for the Site Plan for MEP/Finishes Phase of Construction*

During the MEP/Finishes phase of construction, the different key feature is the new crane location. However, the crane can be place anywhere on the east and west sides of the building. During installing of MEP system components and finishes, the crane is used to install the new steam vault at the north end of the site, move any rooftop equipment to the roof, and place any large equipment that might be installed on the upper floors. In addition, much like the demolition phase, material storage is located in and around the building, and major transportation equipment such as personnel and material hoists are not needed because of the existing operable elevators inside the building.



Contractor Layout Critique

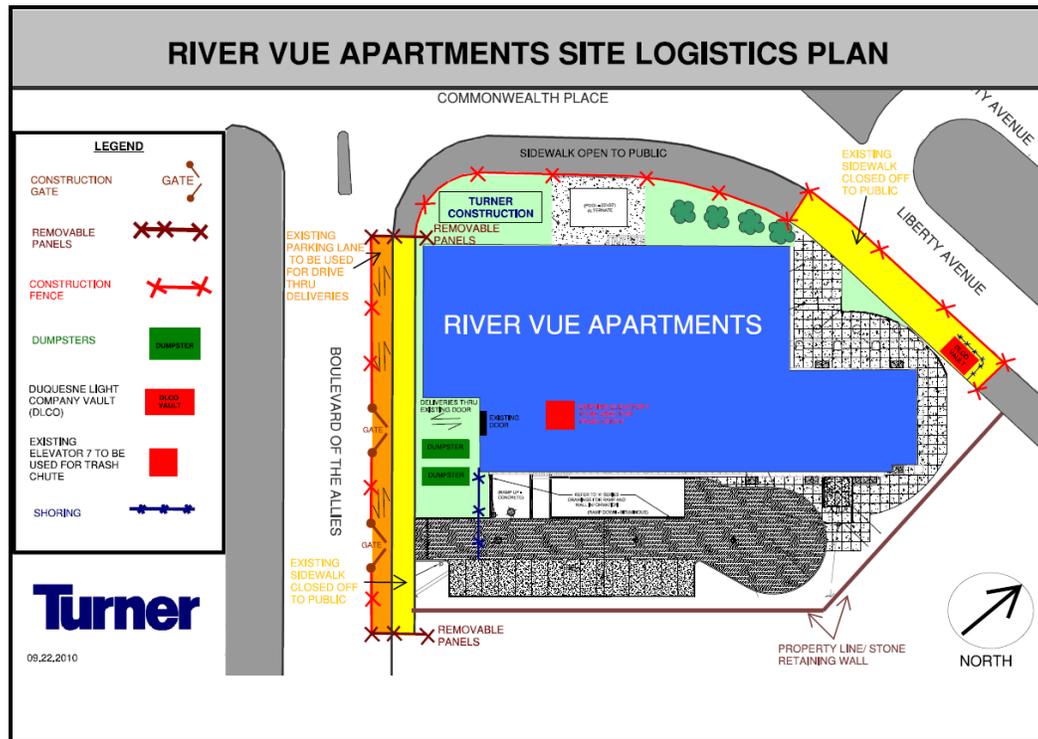


Figure 10 – Turner Construction Company’s Site Logistics Plan for River Vue Apartments

Visiting the River Vue Apartments construction site on August 4, 2011 provided the opportunity of seeing the site logistics plan in effect. However, when on the tour of the site, some of the features were placed in different locations throughout the site. For instance, the dumpsters were located near the stone retaining wall. Also, there are a couple of major issues with the layout provided by Turner. The first issue is the lack of different site logistics plans for the different phases of construction for the River Vue Apartments building. During those phases of construction, this aspect could lead to confusion or frustration because a plan was not created beforehand to solve site layout issues that could occur. The other issue is the lack of certain details. The site plan, shown in Figure 10, is lacking information about material storage and lay down areas, crane locations, temporary toilets, Turner’s field office location, and vehicular traffic pedestrian patterns. However, it depends on the view point of the general contractor to determine what information and detail is important to be on the site logistics plan.

The layouts shown in Appendixes D, E, F, and G are very similar to the layout and technical plans that were created by the general contractor. However, there are a few key changes. These changes include showing separate site plans for the three major phases of construction for the project, the excavation areas, the excavation support system, crane location, and material and soil storage areas. These changes provide clarity for some of the identified issues.



Local Conditions

Preferred Methods of Construction

The City of Pittsburgh Code of Ordinances determines the local construction conditions and preferred methods of construction for the Pittsburgh area. The first condition pertains to renovation projects. The code states that the construction of renovations has to “rehabilitate an existing structure to the highest level standards for safety, health, and economic or social amenity” (“Pittsburgh City Code” et al.). The next condition for renovation projects is the “qualified conversion to commercial residential use” code. The code states that “improvements having the effect of converting all or a portion of deteriorated property to commercial residential use must be deemed qualified” (“Pittsburgh City Code” et al.). The final condition for renovation projects is that “at least fifty percent of the total building area, measured by floor area between ground level and the roof, must be used for parking by residents or guests only, not by the public” (“Pittsburgh City Code” et al.).



Figure 11 – 3D View of Project Location from Google Earth

During the construction of River Vue Apartments, no parking is available on site. Project personnel and labor workers are able to park in the Gateway Center Parking Garage or in any other parking garages and parking areas located throughout the city. In addition, there are no particular fees that need to be noted for recycling and tipping fees. For the recycling on the project, dumpsters are staged on site temporarily and removed continually during the demolition phase and throughout the construction phase as well.

Soil Evaluation

Since the existing building was constructed in the 1950s, a geotechnical report for the River Vue Apartments project is not available because it does not exist. Therefore, to determine the soil and subsurface water conditions, the soil type will be assumed for analysis. According to Pennsylvania State University’s soil map website, the soil located on the River Vue Apartments site is urban land (UB), shown in Figure 12. Some properties of the soil include very deep bedrock depths, seasonal water table of less than 60 inches, and no flooding potential (“Soil Map” et al.). One water condition is free water and it is water naturally added to soil by rain or the melting of snow.



Figure 12 – Soil Map of Allegheny County, Pittsburgh

In addition, found on the S-000 drawing sheet provided by Turner Construction Company, the following soil values were used for design purposes and verified. The on-site material represents the soil that is an existing condition on the site.

On-Site Material:

- In Place Soil Unit Weight = 120 PCF
- Active = 50 PCF
- At Rest = 70 PCF
- Passive = 295 PCF
- Coefficient of Friction = 0.30



Client Information

For the River Vue Apartments project, the owner is River Vue Associates, LP (RVA) located in Canonsburg, PA. They are an affiliate of Millcraft Industries, Inc. Since information about River Vue Associates is unavailable at this time, this section of the technical assignment will include information about Millcraft Industries, Inc.

According to the company's official website, "Millcraft Industries, Inc. is a Pittsburgh-based real estate developer and management company with a fifty-year history of successfully creating and maintaining prominent large-scale office, retail, and mixed-use developments. Millcraft's Real Estate Division is a multi-million dollar operation, which has participated in and directed a variety of real estate ventures, including sustainable mixed-use projects, historical renovations, commercial office buildings, retail centers, hotels and restaurants, and residential development" ("Our Company" et al.).

In the Pittsburgh market, apartment buildings are properties in high demand. Therefore, the main reason Millcraft Industries, Inc. is building this facility is to develop a residential apartment building in one of the most convenient locations in the city of Pittsburgh. The company is expecting young professionals and families to rent in the downtown apartment units that will offer some of the best views of the city to its residences.

There are several quality, schedule, cost, and safety expectations for the project.

Quality

Quality of the finished building is one of the main concerns for the Millcraft. It is important to them, as a company, to develop a project to the highest quality in looks and function. For the new look of the River Vue Apartments building, new operable bronze-colored panels will be used for the window system and new recessed balconies on the top two floors will be installed. For the function of the new building, tenants will have apartment units that average roughly 850 square feet and other amenities such as a fitness center, media and recreation room, retail shops, and valet parking. In addition, new mechanical, electrical, plumbing, fire protection, and roofing systems will be installed into the building to provide the highest quality of MEP/FP building systems.

Schedule

The construction of River Vue Apartments started on June 13, 2011. Pre-leasing for potential tenants will begin in early fall. Since occupancy into the new apartment units will be phased, the schedule of the project is another main concern for the owner. As construction is completed per floor, roughly 30 apartment units will be ready for occupancy each month starting with the lower floors. If the schedule of construction is changed or delayed, it affects the move-in periods for the tenants and overall completion date of the project. For instance, the schedule can be delayed because of sequencing issues for the mechanical, electrical, and plumbing systems and the interior finishes of the individual



apartment units. These issues are of interest to the owner since full completion and occupancy of the River Vue Apartments building is expected to be in October 2012.

Cost

Even though cost is not a major concern, it is necessary to develop a budget that meets the requirements for the new River Vue Apartments building. Millcraft expects to spend roughly \$40 million on the project; however, the total project cost, estimated by Turner Construction Company, is to be approximately \$29 million.

Safety

For all of Millcraft's projects, safety is expected to be maintained during the construction and the permanent use of their buildings. For River Vue Apartments, the owner has trusted Turner Construction Company to develop a safety plan for the construction site that follows all necessary regulations and codes. Their main goal is to keep personnel on site and pedestrians and vehicular traffic around the site safe at all times.

For Turner Construction Company, the key to completing the project to the owner's satisfaction is to execute Millcraft's quality, schedule, cost, and safety expectations and to keep them in mind as the main priority.



Project Delivery System

The project delivery system is a HUD-92442-A Cost Plus Construction Contract. The owner, River Vue Associates (RVA), holds different contracts with three of the main project team companies and a mechanical and hydraulic engineering company for the hydraulic parking car-lift system. RVA holds a cost plus construction contract with Turner Construction Company to provide general construction services. Also, for the parking car-lift system, RVA has an assumed lump sum contractual relationship with Harding Steel, Inc. based on their interactions. Even though these main contracts are held with the owner, there is communication between the three main project team companies. This communication system is shown in Figure 13 below.

For the new luxury apartment renovation's design, two private architectural firms were hired to perform the design in contract with the owner. For the River Vue Apartments project, Design4 Studio, Inc. and Intelligent Design Group (IDG), LLP are the architects, and they have developed a joint venture. It is a special-purpose partnership that combines the resources, assets, and skills of the two firms. The two architectural firms' lump sum contracts with RVA include the AIA Document B181-1994 "Standard Form of Agreement Between Owner and Architect for Housing Services," including the HUD Amendment. In addition, the architects have assumed lump sum contracts with the structural engineers (Whitney Bailey Cox & Magnani, LLC), MEP/FP engineers (Claitman Engineering Associates, Inc.), and civil engineers (Gateway Engineers). These lump sums are agreements to perform the design work for a fixed price regardless of the cost. These engineers have a strong communication system between each other and the architects for coordination.

Since they are completely removed from the design process, Turner Construction Company does not become active in the project until the construction phase. After the competitive bidding period was over, Turner was awarded the project to only provide general construction services. They are not providing construction management services because there is no construction manager for the River Vue Apartments project. To RVA, Turner assumes "full responsibility for the construction of the project within the specified time and within full accordance with the contract items. Coordination and direction of all the tasks and activities of the various subcontractors and agencies involved with the construction phase are other distinctive functions of the general contractor" (Clough, G. Sears, and S. Sears 12-13).

In addition, Turner hires various qualified specialties contractors to complete the specialties work. The subcontractors include concrete, earth work, electrical, masonry, mechanical, and all other subcontractors. Even though Turner Construction Company is performing their own concrete work for the interior metal deck in-fills, Brayman Construction Corporation and Modany-Falcone Inc. are performing the project's other concrete work. Brayman Construction Corporation is placing the concrete for the exterior foundations, and Modany-Falcone Inc. is placing the concrete for site paving. Also, the subcontractors do not have a contractual relationship with the owner. Since information is not available at this time, it is assumed that these subcontractors have lump sum contracts with Turner Construction Company based on their interactions.



For Turner Construction Company, maintaining insurance and bonds with their chosen subcontractors is very important. The subcontractors must maintain All-Risk Builder's Risk Insurance, and they must hold Commercial Automotive Liability Insurance, Commercial General Liability Insurance, and Workers' Compensation and Employers' Liability Insurance. Also, these subcontractors, along with Turner Construction Company, are responsible for performance and payment bonds. These types of bonds "primarily act for the protection of the third parties to the contract and guarantee payment for labor and materials used or supplied in the performance of construction" (Clough, G. Sears, and S. Sears 174 and 178).

In Figure 13, the project delivery system and the contract types are appropriate and logical for the River Vue Apartments project. Since its complexities lie in demolition, abatement of asbestos, and installation of new building systems, it is very important to have a general contract that is experienced in the construction industry. Turner Construction Company's reputation as one of the nation's leading construction companies and their experience with developmental construction in the Pittsburgh area makes them the right candidate for the new luxury apartment renovation project. Also, the qualified subcontractors they have chosen to perform the specialties work are appropriate as well.

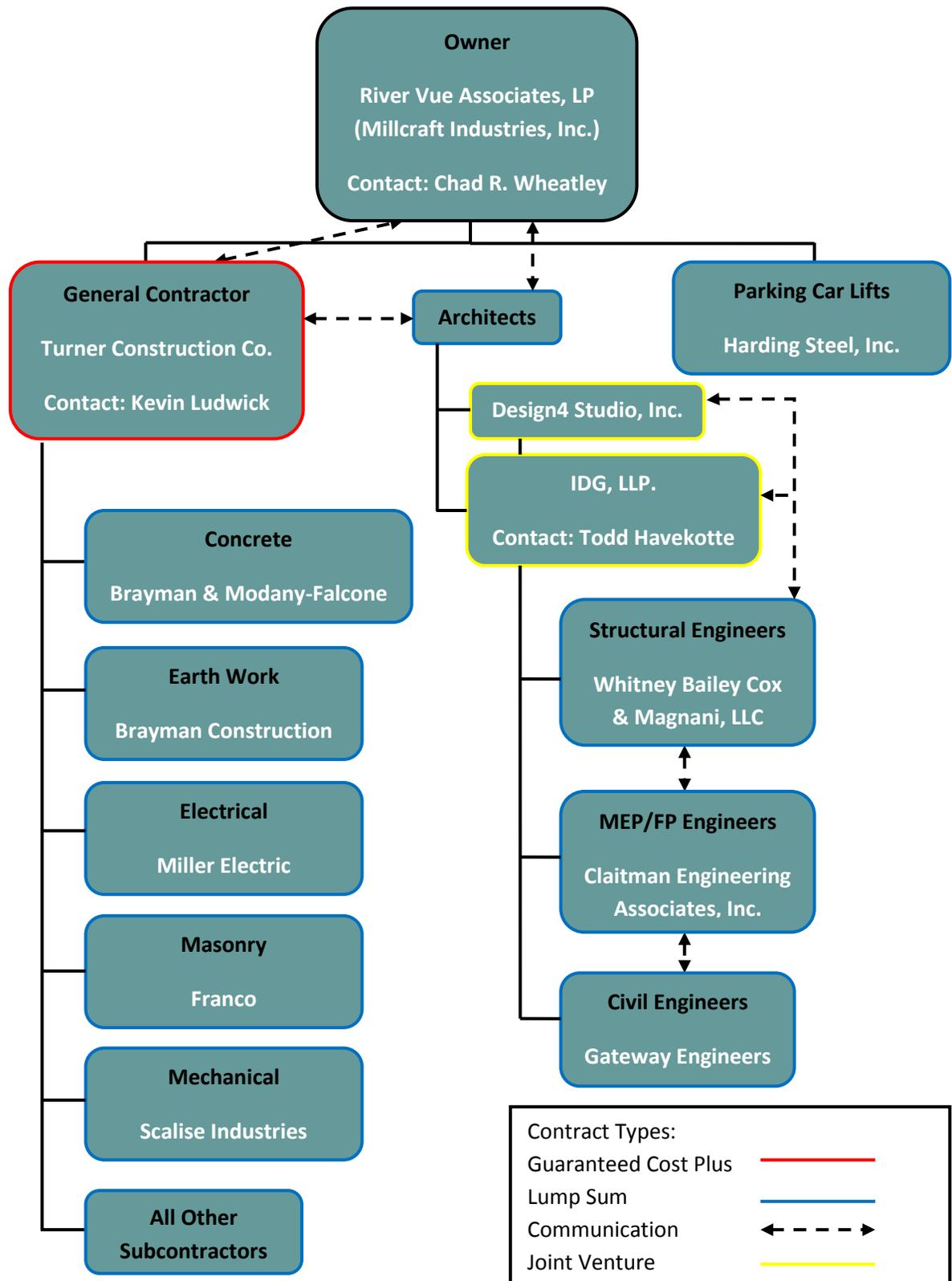


Figure 13: Project Delivery System of the River Vue Apartments Project



Turner Construction Company's Staffing Plan

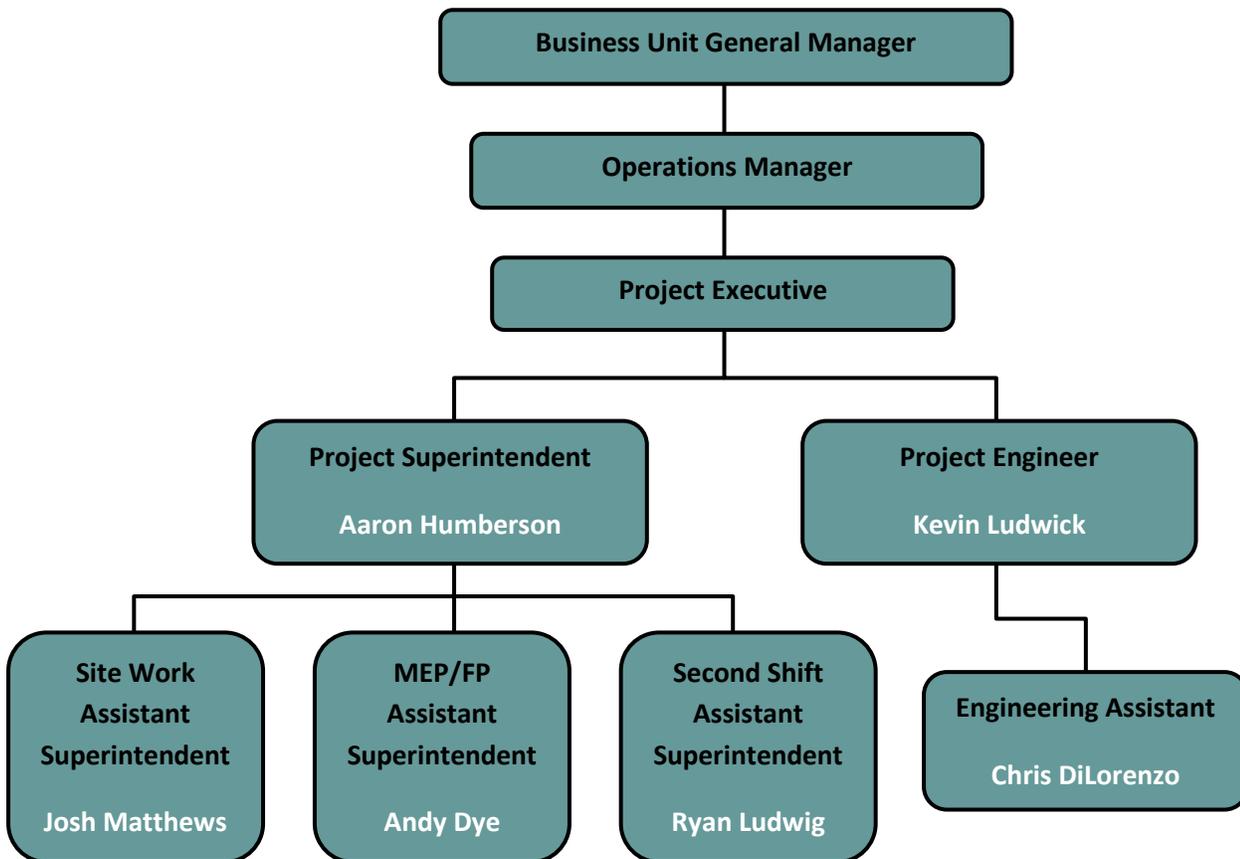


Figure 14: Turner Construction Co. (General Contractor) Staffing Plan for River Vue

According to Turner Construction Company's official website, their Pittsburgh office's goal for their projects is to "provide their clients with the highest level experience, staff, and resources in the construction industry" ("Pittsburgh Building the Future" et al.). With this goal in consideration, Turner develops the staffing plans for their projects based on the experiences of the staff members and the project's size. Figure 14 shows the staffing plan diagram for the River Vue Apartments project. Since the staffing plan developed for this project is smaller compared to other projects of the same size, it reflects the level of complexity of the project as well.

Also, shown in Figure 14, the staffing plan diagram starts with the management staff, which includes the business unit general manager, operations manager, and project executive. These staff members are usually assigned several projects at a time. Therefore, their offices are located at the main Pittsburgh office headquarters to ensure that they are available to discuss and work on their other projects.



However, they visit the River Vue Apartments project's site on a regular basis to track its progress and hold progress, safety, and conflict resolution meetings with the field staff.

For this particular project, the field staff includes the project superintendent, site work assistant superintendent, MEP and FP assistant superintendent, second shift assistant superintendent, project engineer, and engineering assistant. These staff members take care of all the components that are a part of the construction progress, including major construction issues that may occur on site. Therefore, their offices are located on the job site usually in field trailers. However, since River Vue Apartments is a renovation project, Turner's field staff is occupying the future retail space area in the building for their office space. In addition, on the site, any daily safety related issues that occur during the construction process can be handled by the experienced field staff members.



References

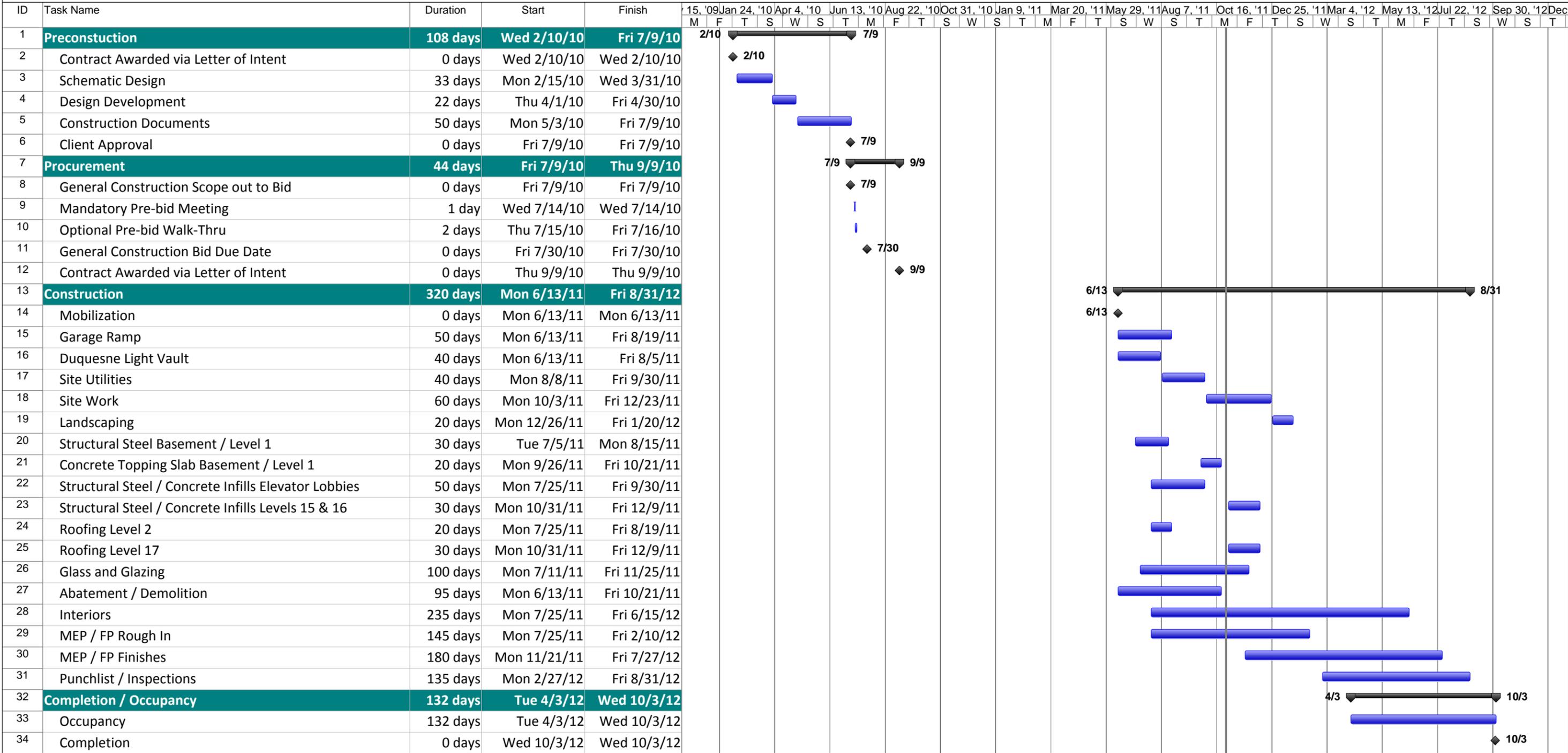
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Appendix A: Project Schedule Summary

Project Schedule Summary

River Vue Apartments | Pittsburgh, PA



Project Schedule Summary River Vue Apartments Date: 10/28/2011	Task		Rolled Up Progress		Inactive Task		Manual Summary Rollup		Deadline	
	Milestone		Split		Inactive Milestone		Manual Summary			
	Summary		External Tasks		Inactive Summary		Start-only			
	Rolled Up Task		Project Summary		Manual Task		Finish-only			
	Rolled Up Milestone		Group By Summary		Duration-only		Progress			



Appendix B: RS Means Cost Works 2010 Reports



Total Building Construction Cost Square Foot Estimate

**Information from <http://www.meanscostworks.com/>*

Estimate Name:	River Vue Apartments Renovation Square Foot Estimate 300 Liberty Avenue , Pittsburgh , PA , 15222
Building Type:	Apartment, 8-24 Story with Face Brick with Concrete Block Back-up / Steel Frame
Location:	PITTSBURGH, PA
Story Count:	15
Story Height (L.F.):	12
Floor Area (S.F.):	295000
Labor Type:	Union
Basement Included:	Yes
Data Release:	Year 2010 Quarter 1
Cost Per Square Foot:	\$137.26
Building Cost:	\$40,492,000



Costs are derived from a building model with basic components.

Scope differences and market conditions can cause costs to vary significantly.

		% of Total	Cost Per S.F.	Cost
A Substructure		10.97%	\$15.06	\$4,443,000
A1010	Standard Foundations Pile caps, 6 piles, 8' - 6" x 5' - 6" x 37", 40 ton capacity, 14" column size, 458 K column Pile caps, 12 piles, 11' - 6" x 8' - 6" x 49", 40 ton capacity, 19" column size, 900 K column		\$0.59	\$173,000
A1020	Special Foundations Steel H piles, 100' long, 400K load, end bearing, 6 pile cluster Steel H piles, 100' long, 800K load, end bearing, 12 pile cluster Grade beam, 30' span, 52" deep, 14" wide, 12 KLF load		\$13.40	\$3,952,500
A1030	Slab on Grade Slab on grade, 4" thick, non industrial, reinforced		\$0.33	\$96,000
A2010	Basement Excavation Excavate and fill, 10,000 SF, 8' deep, sand, gravel, or common earth, on site storage		\$0.24	\$71,000
A2020	Basement Walls Foundation wall, CIP, 12' wall height, pumped, .591 CY/LF, 28.79 PLF, 16" thick		\$0.51	\$150,500
B Shell		19.75%	\$27.11	\$7,997,500
B1010	Floor Construction Cast-in-place concrete column, 24" square, tied, 900K load, 12' story		\$15.66	\$4,620,500



	height, 567 lbs/LF, 4000PSI Flat slab, concrete, with drop panels, 6" slab/2.5" panel, 12" column, 15'x15' bay, 75 PSF superimposed load, 153 PSF total load Floor, concrete, slab form, open web bar joist @ 2' OC, on W beam and column, 20'x25' bay, 26" deep, 65 PSF superimposed load, 110 PSF total load Fireproofing, gypsum board, fire rated, 1 layer, 1/2" thick, 14" steel column, 2 hour rating, 18 PLF			
B1020	Roof Construction Roof, steel joists, 1.5" 22 ga metal deck, on bearing walls, 25' bay, 17.5" deep, 30 PSF superimposed load, 50 PSF total load	\$0.22	\$63,500	
B2010	Exterior Walls Brick wall, composite double wythe, standard face/CMU back-up, 8" thick, perlite core fill	\$8.44	\$2,489,500	
B2020	Exterior Windows Windows, aluminum, sliding, standard glass, 5' x 3'	\$2.25	\$663,000	
B2030	Exterior Doors Door, aluminum & glass, without transom, wide stile, hardware, 3'-0" x 7'-0" opening Door, aluminum & glass, without transom, non-standard, double door, hardware, 6'-0" x 7'-0" opening	\$0.16	\$46,000	
B3010	Roof Coverings Roofing, asphalt flood coat, gravel, base sheet, 3 plies 15# asphalt felt, mopped Insulation, rigid, roof deck, composite with 2" EPS, 1" perlite Roof edges, aluminum, duranodic, .050" thick, 6" face Flashing, aluminum, no backing sides, .019" Gravel stop, aluminum, extruded, 4", mill finish, .050" thick	\$0.39	\$115,000	
C Interiors		23.70%	\$32.53	\$9,596,000
C1010	Partitions Concrere block (CMU) partition, light weight, hollow, 6" thick, no finish Metal partition, 5/8" fire rated gypsum board face, 1/4" sound deadening gypsum board, 2-1/2" @ 24", same opposite face, no insulation Furring 1 side only, steel channels, 3/4", 16" OC Gypsum board, 1 face only, exterior sheathing, fire resistant, 1/2" Add for the following: taping and finishing 1/2" fire rated gypsum board, taped & finished, painted on metal furring	\$9.32	\$2,750,000	
C1020	Interior Doors Door, single leaf, wood frame, 3'-0" x 7'-0" x 1-3/8", birch, solid core Door, single leaf, wood frame, 3'-0" x 7'-0" x 1-3/8", birch, hollow core	\$6.10	\$1,799,000	
C1030	Fittings Cabinets, residential, wall, two doors x 48" wide	\$3.32	\$980,000	



C2010	Stair Construction Stairs, steel, cement filled metal pan & picket rail, 12 risers, with landing	\$2.83	\$834,500
C3010	Wall Finishes Painting, interior on plaster and drywall, walls & ceilings, roller work, primer & 2 coats Vinyl wall covering, fabric back, medium weight Ceramic tile, thin set, 4-1/4" x 4-1/4"	\$2.55	\$753,500
C3020	Floor Finishes Carpet tile, nylon, fusion bonded, 18" x 18" or 24" x 24", 24 oz Carpet tile, nylon, fusion bonded, 18" x 18" or 24" x 24", 35 oz Carpet, padding, add to above, minimum Carpet, padding, add to above, maximum Vinyl, composition tile, minimum Vinyl, composition tile, maximum Tile, ceramic natural clay	\$4.77	\$1,408,500
C3030	Ceiling Finishes Gypsum board ceilings, 1/2" fire rated gypsum board, painted and textured finish, 7/8" resilient channel furring, 24" OC support	\$3.63	\$1,070,500
D Services		43.09%	\$59.15
			\$17,448,000
D1010	Elevators and Lifts Traction, geared passenger, 3500 lb, 15 floors, 10' story height, 2 car group, 350 FPM	\$13.97	\$4,121,500
D2010	Plumbing Fixtures Kitchen sink w/trim, countertop, PE on CI, 24" x 21", single bowl Laundry sink w/trim, PE on CI, black iron frame, 24" x 20", single compt Service sink w/trim, PE on CI, corner floor, 28" x 28", w/rim guard Bathroom, lavatory & water closet, 2 wall plumbing, stand alone Bathroom, three fixture, 2 wall plumbing, lavatory, water closet & bathtub, stand alone	\$13.35	\$3,938,500
D2020	Domestic Water Distribution Gas fired water heater, residential, 100< F rise, 30 gal tank, 32 GPH	\$2.19	\$647,500
D2040	Rain Water Drainage Roof drain, DWV PVC, 4" diam, diam, 10' high Roof drain, DWV PVC, 4" diam, for each additional foot add	\$0.08	\$24,500
D3010	Energy Supply Apartment building heating system, fin tube radiation, forced hot water, 30,000 SF area, 300,000 CF vol	\$6.78	\$2,001,000
D3030	Cooling Generating Systems Packaged chiller, air cooled, with fan coil unit, medical centers, 40,000 SF, 93.33 ton	\$8.26	\$2,435,500
D4010	Sprinklers Wet pipe sprinkler systems, steel, light hazard, 1 floor, 10,000 SF	\$2.62	\$771,500



	Wet pipe sprinkler systems, steel, light hazard, each additional floor, 10,000 SF			
D4020	Standpipes	\$0.61	\$180,500	
	Wet standpipe risers, class III, steel, black, sch 40, 6" diam pipe, 1 floor			
D5010	Electrical Service/Distribution	\$1.02	\$300,000	
	Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 2000 A			
	Feeder installation 600 V, including RGS conduit and XHHW wire, 2000 A			
	Switchgear installation, incl switchboard, panels & circuit breaker, 2000 A			
D5020	Lighting and Branch Wiring	\$7.27	\$2,144,500	
	Receptacles incl plate, box, conduit, wire, 10 per 1000 SF, 1.2 W per SF, with transformer			
	Wall switches, 2.5 per 1000 SF			
	Miscellaneous power, 2 watts			
	Central air conditioning power, 3 watts			
	Motor installation, three phase, 460 V, 15 HP motor size			
	Motor feeder systems, three phase, feed to 200 V 5 HP, 230 V 7.5 HP, 460 V 15 HP, 575 V 20 HP			
	Incandescent fixtures recess mounted, type A, 1 watt per SF, 8 FC, 6 fixtures per 1000 SF			
D5030	Communications and Security	\$2.81	\$827,500	
	Communication and alarm systems, fire detection, non-addressable, 100 detectors, includes outlets, boxes, conduit and wire			
	Communication and alarm systems, includes outlets, boxes, conduit and wire, intercom systems, 100 stations			
	Communication and alarm systems, includes outlets, boxes, conduit and wire, master TV antenna systems, 30 outlets			
	Internet wiring, 2 data/voice outlets per 1000 S.F.			
D5090	Other Electrical Systems	\$0.19	\$55,500	
	Generator sets, w/battery, charger, muffler and transfer switch, gas/gasoline operated, 3 phase, 4 wire, 277/480 V, 80 kW			
E Equipment & Furnishings		2.49%	\$3.42	\$1,007,500
E1090	Other Equipment	\$3.42	\$1,007,500	
	300 - Detection Systems, heat detector, smoke detector, ceiling type, excl. wires & conduit			
	218 - Laundry equipment, washer, residential, 4 cycle, average			
	218 - Laundry equipment, dryers, gas-fired residential, 16 lb capacity, average			
	218 - Refrigerator, residential appliances, no frost, 10 to 12 C.F., minimum			
	218 - Range hood, residential appliances, vented, min, 2 speed, 30" wide, minimum			
	218 - Dishwasher, residential appliances, built-in, 2 cycles, minimum			
	218 - Microwave ovens, residential appliances, minimum			
	218 - Cooking range, residential appliances, free standing, 1 oven,			



30" wide, minimum			
F Special Construction	0.00%	\$0.00	\$0
G Building Sitework	0.00%	\$0.00	\$0
SubTotal	100%	\$137.26	\$40,492,000
Contractor Fees (General Conditions,Overhead,Profit)	0.00%	\$0.00	\$0
Architectural Fees	0.00%	\$0.00	\$0
User Fees	0.00%	\$0.00	\$0
Total Building Cost		\$137.26	\$40,492,000



Revised Total Building Construction Cost Square Foot Estimate with MEP Assemblies Cost

**Information from <http://www.meanscostworks.com/>*

Estimate Name:	River Vue Apartments Renovation Square Foot Estimate - Revised 300 Liberty Avenue , Pittsburgh , PA , 15222
Building Type:	Apartment, 8-24 Story with Face Brick with Concrete Block Back-up / Steel Frame
Location:	PITTSBURGH, PA
Story Count:	15
Story Height (L.F.):	12
Floor Area (S.F.):	295000
Labor Type:	Union
Basement Included:	Yes
Data Release:	Year 2010 Quarter 1
Cost Per Square Foot:	\$137.26
Building Cost:	\$40,492,000



Costs are derived from a building model with basic components.

Scope differences and market conditions can cause costs to vary significantly.

		% of Total	Cost Per S.F.	Cost
A Substructure				
N/A				
B Shell		3.76%	\$2.79	\$824,000
B2020	Exterior Windows Windows, aluminum, sliding, standard glass, 5' x 3'		\$2.25	\$663,000
B2030	Exterior Doors Door, aluminum & glass, without transom, wide stile, hardware, 3'-0" x 7'-0" opening Door, aluminum & glass, without transom, non-standard, double door, hardware, 6'-0" x 7'-0" opening		\$0.16	\$46,000
B3010	Roof Coverings Roofing, asphalt flood coat, gravel, base sheet, 3 plies 15# asphalt felt, mopped Insulation, rigid, roof deck, composite with 2" EPS, 1" perlite Roof edges, aluminum, duranodic, .050" thick, 6" face Flashing, aluminum, no backing sides, .019" Gravel stop, aluminum, extruded, 4", mill finish, .050" thick		\$0.39	\$115,000
C Interiors		40.10%	\$29.70	\$8,761,500
C1010	Partitions Concrecre block (CMU) partition, light weight, hollow, 6" thick, no finish		\$9.32	\$2,750,000



	<p>Metal partition, 5/8" fire rated gypsum board face, 1/4" sound deadening gypsum board, 2-1/2" @ 24", same opposite face, no insulation</p> <p>Furring 1 side only, steel channels, 3/4", 16" OC</p> <p>Gypsum board, 1 face only, exterior sheathing, fire resistant, 1/2"</p> <p>Add for the following: taping and finishing</p> <p>1/2" fire rated gypsum board, taped & finished, painted on metal furring</p>			
C1020	Interior Doors		\$6.10	\$1,799,000
	<p>Door, single leaf, wood frame, 3'-0" x 7'-0" x 1-3/8", birch, solid core</p> <p>Door, single leaf, wood frame, 3'-0" x 7'-0" x 1-3/8", birch, hollow core</p>			
C1030	Fittings		\$3.32	\$980,000
	Cabinets, residential, wall, two doors x 48" wide			
C3010	Wall Finishes		\$2.55	\$753,500
	<p>Painting, interior on plaster and drywall, walls & ceilings, roller work, primer & 2 coats</p> <p>Vinyl wall covering, fabric back, medium weight</p> <p>Ceramic tile, thin set, 4-1/4" x 4-1/4"</p>			
C3020	Floor Finishes		\$4.77	\$1,408,500
	<p>Carpet tile, nylon, fusion bonded, 18" x 18" or 24" x 24", 24 oz</p> <p>Carpet tile, nylon, fusion bonded, 18" x 18" or 24" x 24", 35 oz</p> <p>Carpet, padding, add to above, minimum</p> <p>Carpet, padding, add to above, maximum</p> <p>Vinyl, composition tile, minimum</p> <p>Vinyl, composition tile, maximum</p> <p>Tile, ceramic natural clay</p>			
C3030	Ceiling Finishes		\$3.63	\$1,070,500
	Gypsum board ceilings, 1/2" fire rated gypsum board, painted and textured finish, 7/8" resilient channel furring, 24" OC support			
D Services		45.90%	\$59.15	\$10,059,056
D2010	Plumbing Fixtures		\$10.09	\$2,976,884
D2020	Domestic Water Distribution		\$4.69	\$1,383,478
D2040	Rain Water Drainage		\$0.02	\$5,191
D2090			\$0.89	\$261,259
D3010	Energy Supply		\$8.50	\$2,508,638
D3050			\$0.54	\$158,550
D4010	Sprinklers		\$0.43	\$125,636
D4020	Standpipes		\$0.22	\$63,916
D5010	Electrical Service/Distribution		\$1.07	\$314,242
D5020	Lighting and Branch Wiring		\$3.11	\$917,340
D5030	Communications and Security		\$4.56	\$1,343,922
E Equipment & Furnishings		4.60%	\$3.42	\$1,007,500



E1090	Other Equipment 300 - Detection Systems, heat detector, smoke detector, ceiling type, excl. wires & conduit 218 - Laundry equipment, washer, residential, 4 cycle, average 218 - Laundry equipment, dryers, gas-fired residential, 16 lb capacity, average 218 - Refrigerator, residential appliances, no frost, 10 to 12 C.F., minimum 218 - Range hood, residential appliances, vented, min, 2 speed, 30" wide, minimum 218 - Dishwasher, residential appliances, built-in, 2 cycles, minimum 218 - Microwave ovens, residential appliances, minimum 218 - Cooking range, residential appliances, free standing, 1 oven, 30" wide, minimum	\$3.42	\$1,007,500
F Special Construction		0.00%	\$0.00
G Building Sitework		0.00%	\$0.00
SubTotal		94%	\$70.01
Contractor Fees (General Conditions,Overhead,Profit)		2.83%	\$2.10
Architectural Fees		2.83%	\$2.10
Total Building Cost		\$74.21	\$21,891,179



Appendix C: Assemblies Cost Estimate for the MEP System



RIVER VUE APARTMENTS | PITTSBURGH, PA | October 28, 2011

Assemblies Cost Estimate for the MEP Systems

Assemblies Cost Estimate for the MEP Systems										
Assembly Number	Quantity	Description	Unit	Material O&P	Installation O&P	Total O&P	Ext. Material O&P	Ext. Installation O&P	Ext. Total O&P	Notes
020101101920	218	Water closet, vitreous china, tank type, floor mount, 1 piece	Ea.	\$ 975.57	\$ 705.00	\$ 1,680.57	\$ 212,674.26	\$ 153,690.00	\$ 366,364.26	1 per apartment unit
020103101680	218	Lavatory w/trim, vanity top, cultured marble, 19" x 17"	Ea.	\$ 508.77	\$ 665.00	\$ 1,173.77	\$ 110,911.86	\$ 144,970.00	\$ 255,881.86	1 per apartment unit
020104101960	218	Kitchen sink w/trim, countertop, stainless steel, 33" x 22" double bowl	Ea.	\$ 1,363.70	\$ 785.00	\$ 2,148.70	\$ 297,286.60	\$ 171,130.00	\$ 468,416.60	1 per apartment unit
020105102040	218	Bathtub, recessed, PE on CI, 72" x 36"	Ea.	\$ 2,989.65	\$ 915.00	\$ 3,904.65	\$ 651,743.70	\$ 199,470.00	\$ 851,213.70	1 per apartment unit
020107101960	218	Shower, built-in head, arm, bypass, stops and handles	Ea.	\$ 112.24	\$ 288.00	\$ 400.24	\$ 24,468.32	\$ 62,784.00	\$ 87,252.32	1 per apartment unit
020109262180	218	Bathrooms, three fixture, 2 wall plumbing, lavatory, water closet & bathtub, long plumbing wall common *	Ea.	\$ 2,622.90	\$ 1,725.00	\$ 4,347.90	\$ 571,705.00	\$ 376,050.00	\$ 947,755.00	1 per apartment unit
020202401820	218	Electric water heater, commercial, 100-c F rise, 50 gallon tank, 9 KW 3/76Psi	Ea.	\$ 5,271.23	\$ 1,075.00	\$ 6,346.23	\$ 1,149,328.14	\$ 234,350.00	\$ 1,383,478.14	1 per apartment unit
020402101880	6	Roof drain, DWV PVC, 2" diam, piping, 10' high	Ea.	\$ 240.22	\$ 625.00	\$ 865.22	\$ 1,441.32	\$ 3,750.00	\$ 5,191.32	
020908103010	6749	Pipe plastic, PVC, DWV, pressure pipe 200 PSI, 1/2" diameter	L.F.	\$ 1.78	\$ 11.55	\$ 13.33	\$ 12,013.22	\$ 77,950.95	\$ 89,964.17	
020908103030	6749	Pipe plastic, PVC, DWV, pressure pipe 200 PSI, 3/4" diameter	L.F.	\$ 1.97	\$ 12.25	\$ 14.22	\$ 13,295.53	\$ 82,675.25	\$ 95,970.78	
020908205100	400	Plastic, PVC, high impact/pressure sch 40, 45c elbow, 1/2" diameter	Ea.	\$ 0.79	\$ 18.75	\$ 19.54	\$ 316.00	\$ 7,500.00	\$ 7,816.00	
020908205110	400	Plastic, PVC, high impact/pressure sch 40, 45c elbow, 3/4" diameter	Ea.	\$ 1.23	\$ 22.00	\$ 23.23	\$ 492.00	\$ 8,800.00	\$ 9,292.00	
020908205260	400	Plastic, PVC, high impact/pressure sch 40, 90c elbow, 1/2" diameter	Ea.	\$ 0.47	\$ 18.75	\$ 19.22	\$ 188.00	\$ 7,500.00	\$ 7,688.00	
020908205270	400	Plastic, PVC, high impact/pressure sch 40, 90c elbow, 3/4" diameter	Ea.	\$ 0.53	\$ 22.00	\$ 22.53	\$ 212.00	\$ 8,800.00	\$ 9,012.00	
020908205500	400	Plastic, PVC, high impact/pressure sch 40, tee, 1/2" diameter	Ea.	\$ 0.59	\$ 28.00	\$ 28.59	\$ 236.00	\$ 11,200.00	\$ 11,436.00	
020908205510	400	Plastic, PVC, high impact/pressure sch 40, tee, 3/4" diameter	Ea.	\$ 0.68	\$ 33.00	\$ 33.68	\$ 272.00	\$ 13,200.00	\$ 13,472.00	
020908205680	400	Plastic, PVC, high impact/pressure sch 40, coupling, 1/2" diameter	Ea.	\$ 0.33	\$ 18.75	\$ 19.08	\$ 132.00	\$ 7,500.00	\$ 7,632.00	
020908205690	400	Plastic, PVC, high impact/pressure sch 40, coupling, 3/4" diameter	Ea.	\$ 0.44	\$ 22.00	\$ 22.44	\$ 176.00	\$ 8,800.00	\$ 8,976.00	
PLUMBING SUBTOTAL									\$ 4,625,812.15	
030105101880	30000	Apartment building heating system, fin tube radiation, forced hot water, 30,000 SF area, 300,000 CF vol	S.F.	\$ 2.85	\$ 3.92	\$ 6.78	\$ 85,800.00	\$ 117,600.00	\$ 203,400.00	
030106822580	10	Solar passive heating, direct gain, 3' x 6'-8", double glazed door, two panels wide	Ea.	\$ 2,307.80	\$ 615.00	\$ 2,922.80	\$ 23,078.00	\$ 6,150.00	\$ 29,228.00	
030106842580	900	Solar passive heating, direct gain, 2'-6" x 5', double glazed window, two panels wide	Ea.	\$ 1,153.90	\$ 1,375.00	\$ 2,528.90	\$ 1,038,510.00	\$ 1,237,500.00	\$ 2,276,010.00	
030501551280	3000	Rooftop, multizone, air conditioner, apartment corridors, 3,000 SF, 5.50 ton	S.F.	\$ 10.25	\$ 4.50	\$ 14.75	\$ 30,750.00	\$ 13,500.00	\$ 44,250.00	
030501601440	10000	Self-contained, water cooled unit, apartment corridors, 10,000 SF, 18.33 ton	S.F.	\$ 3.62	\$ 1.98	\$ 5.60	\$ 36,200.00	\$ 19,800.00	\$ 56,000.00	
030501651480	10000	Self-contained, air cooled unit, apartment corridors, 10,000 SF, 18.33 ton	S.F.	\$ 2.87	\$ 2.96	\$ 5.83	\$ 28,700.00	\$ 29,600.00	\$ 58,300.00	
HVAC SUBTOTAL									\$ 2,667,188.00	
040103105250	17353	Dry pipe sprinkler system, copper tubing, ordinary hazard, type M, T-drill, 1 floor, 2000 SF	S.F.	\$ 4.63	\$ 2.61	\$ 7.24	\$ 80,344.39	\$ 45,291.33	\$ 125,635.72	295,000 SF/17 floors = 17,353 SF
040203300600	16	Dry standpipe risers, class I, steel, black, sch 40, 6" diam pipe, additional floors	Floor	\$ 1,547.28	\$ 1,475.50	\$ 3,022.78	\$ 24,756.48	\$ 23,608.00	\$ 48,364.48	16+ basement
040204100500	64	Cabinets, single extinguisher, steel door & frame	Ea.	\$ 107.00	\$ 136.00	\$ 243.00	\$ 6,848.00	\$ 8,704.00	\$ 15,552.00	
FIRE PROTECTION SUBTOTAL									\$ 189,552.20	
050101200560	1	Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 2000 A	Ea.	\$ 30,812.40	\$ 9,859.20	\$ 40,671.60	\$ 30,812.40	\$ 9,859.20	\$ 40,671.60	
050102300560	397	Feeder installation 600 V, including RGS conduit and XHHW wire, 2000 A	L.F.	\$ 323.34	\$ 230.05	\$ 553.39	\$ 128,365.98	\$ 91,329.85	\$ 219,695.83	
050102400400	1	Switchgear installation, incl switchboard, panels & circuit breaker, 2000 A	Ea.	\$ 33,950.70	\$ 19,923.80	\$ 53,874.50	\$ 33,950.70	\$ 19,923.80	\$ 53,874.50	
050201100280	295000	Receptacles incl plate, box, conduit, wire, 4 per 1000 SF, .5 watts per SF	S.F.	\$ 0.45	\$ 1.57	\$ 2.02	\$ 132,750.00	\$ 463,150.00	\$ 595,900.00	
050201300280	295000	Wall switches, 2.0 per 1000 SF	S.F.	\$ 0.10	\$ 0.35	\$ 0.45	\$ 29,500.00	\$ 103,250.00	\$ 132,750.00	
050201400200	295000	Central air conditioning power, 1 watt	S.F.	\$ 0.07	\$ 0.24	\$ 0.31	\$ 20,650.00	\$ 70,800.00	\$ 91,450.00	
050202080520	4000	Fluorescent fixtures, type A, 8 fixtures per 400 SF	S.F.	\$ 2.63	\$ 5.55	\$ 8.18	\$ 10,520.00	\$ 22,200.00	\$ 32,720.00	
050202140400	2000	Incandescent fixtures recess mounted, 100 FC, type A, 34 fixtures per 400 SF	S.F.	\$ 13.31	\$ 18.95	\$ 32.26	\$ 26,620.00	\$ 37,900.00	\$ 64,520.00	
050301100640	295000	Telephone systems, conduit system with floor boxes, low density	S.F.	\$ 1.18	\$ 1.06	\$ 2.24	\$ 348,100.00	\$ 312,700.00	\$ 660,800.00	
050309100210	90	Communication and alarm systems, includes outlets, boxes, conduit and wire, sound systems, 6 outlets	Ea.	\$ 6,062.63	\$ 7,599.80	\$ 13,662.43	\$ 303,131.50	\$ 379,990.00	\$ 683,121.50	
ELECTRICAL SUBTOTAL									\$ 2,575,503.43	
TOTAL MEP SYSTEMS COST									\$ 10,059,055.78	



Appendix D: Existing Conditions Site Plan

LEGEND

RIVER VUE APARTMENTS RENOVATION

EXISTING CONDITIONS SITE PLAN

BRIANNE KYLE
CONSTRUCTION MANAGEMENT

OCTOBER 28, 2011

SYMBOLS:

CONSTRUCTION GATE



REMOVABLE PANELS



CONSTRUCTION FENCE



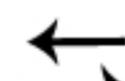
DUQUESNE LIGHT COMPANY VAULT (DLCO)



EXISTING ELEVATOR 7 TO BE USED FOR A TRASH CHUTE



VEHICULAR TRAFFIC



FIRE HYDRANT



EXISTING UTILITIES:

ELECTRIC



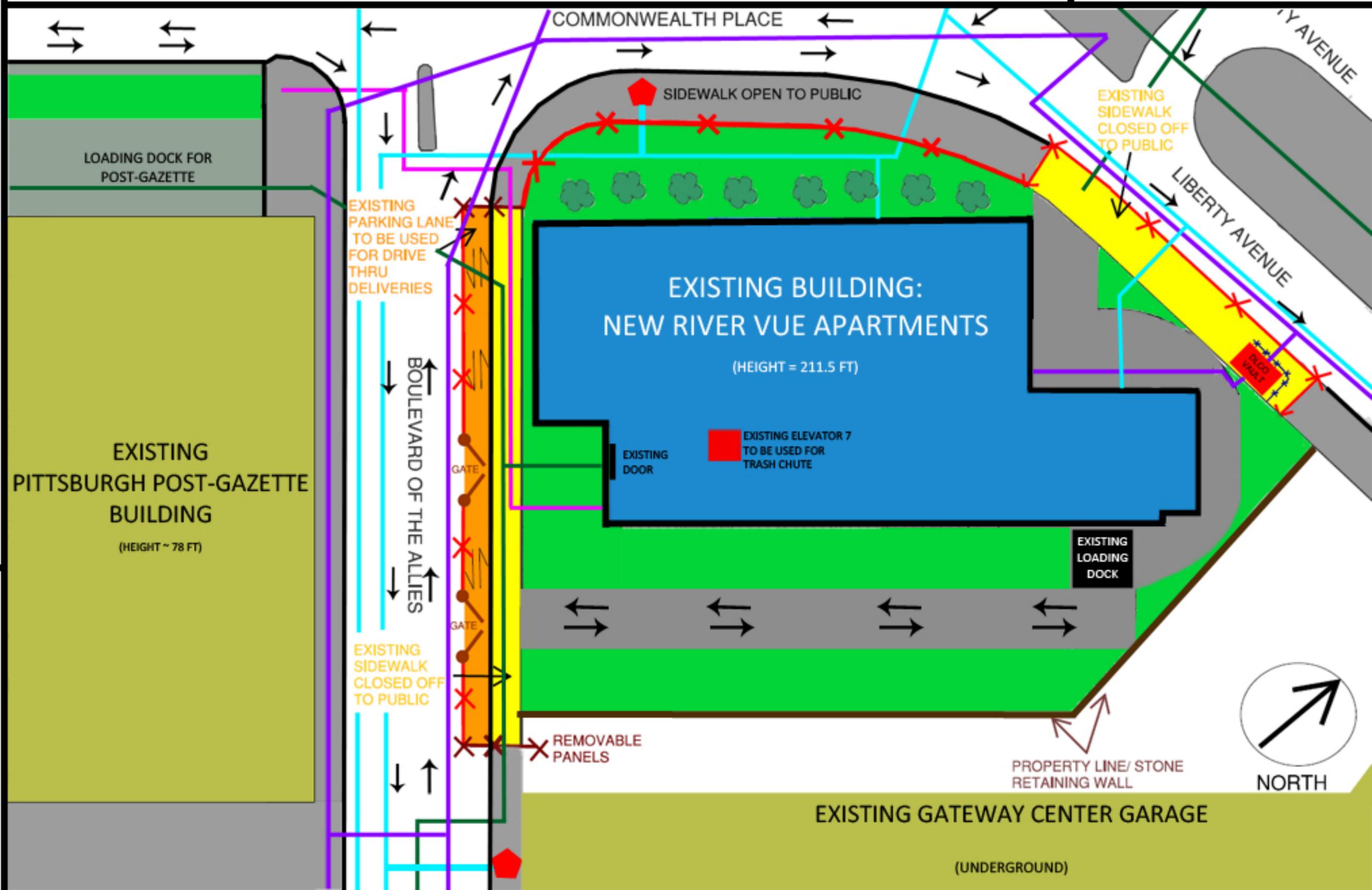
GAS



SANITARY



WATER



Appendix E: Site Plan for Excavation Stage of Construction

LEGEND

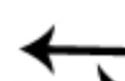
RIVER VUE APARTMENTS RENOVATION

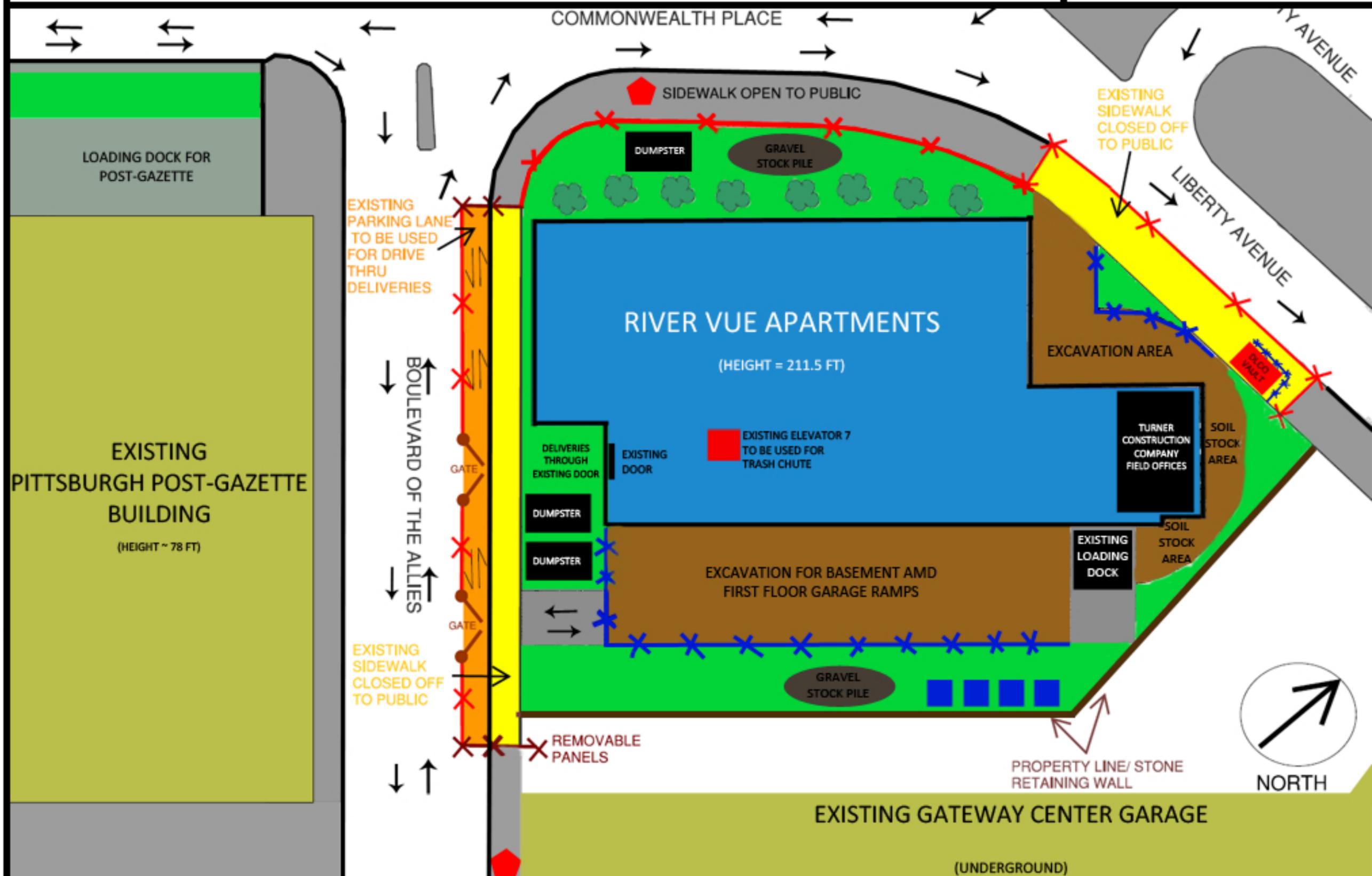
BRIANNE KYLE
CONSTRUCTION MANAGEMENT

OCTOBER 28, 2011

SITE PLAN FOR EXCAVATION PHASE OF CONSTRUCTION

SYMBOLS:

- CONSTRUCTION GATE 
- REMOVABLE PANELS 
- CONSTRUCTION FENCE 
- DUQUESNE LIGHT COMPANY VAULT (DLCO) 
- EXISTING ELEVATOR 7 TO BE USED FOR TRASH CHUTE 
- TEMPORARY TOILETS 
- FIRE HYDRANT 
- SHORING 
- VEHICULAR TRAFFIC 

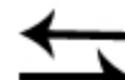




Appendix F: Site Plan for Demolition Phase of Construction

LEGEND

SYMBOLS:

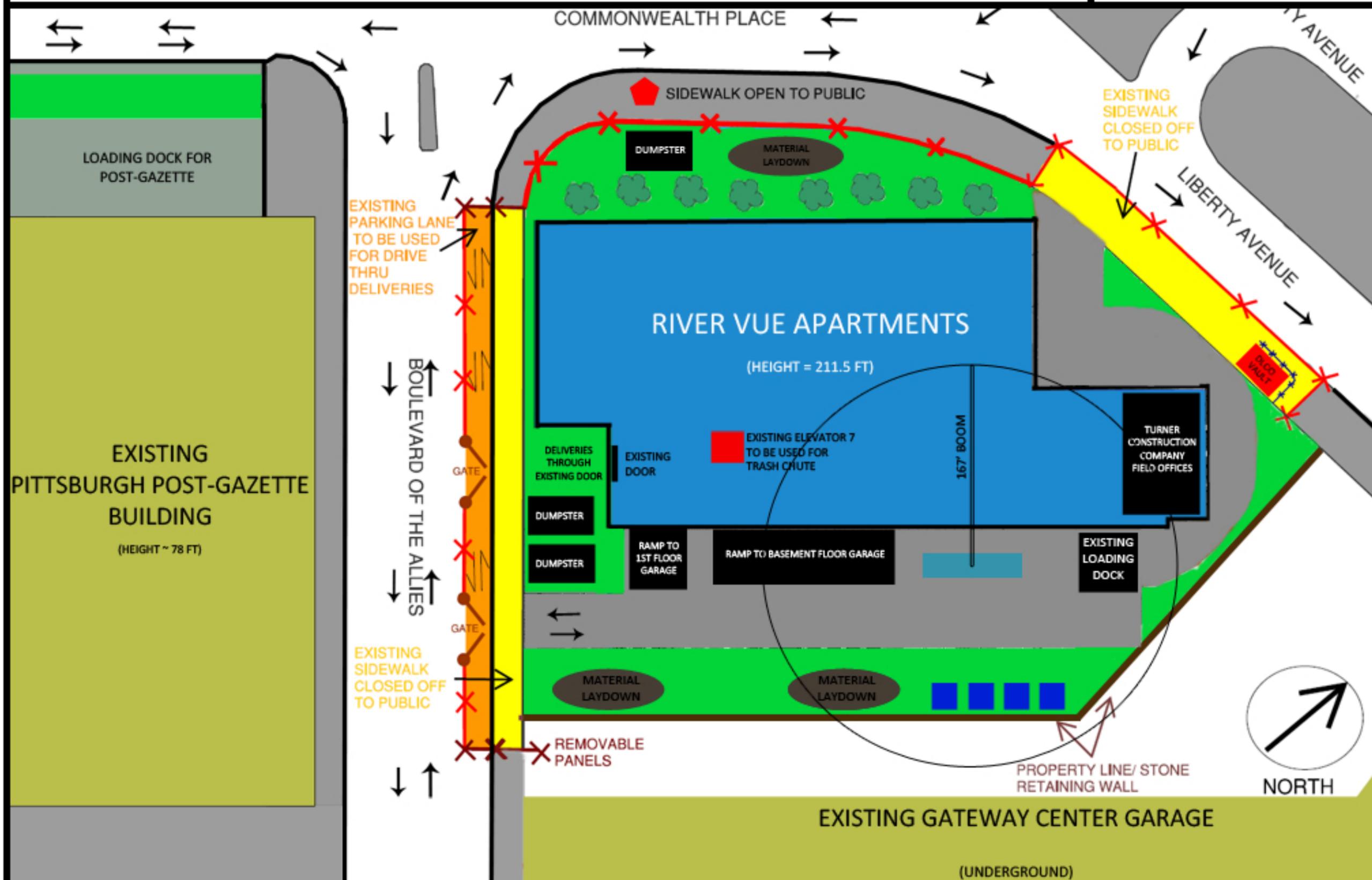
- CONSTRUCTION GATE 
- REMOVABLE PANELS 
- CONSTRUCTION FENCE 
- DUQUESNE LIGHT COMPANY VAULT (DLCO) 
- EXISTING ELEVATOR 7 TO BE USED FOR TRASH CHUTE 
- TEMPORARY TOILETS 
- FIRE HYDRANT 
- TRUCK CRANE 
- VEHICULAR TRAFFIC 

RIVER VUE APARTMENTS RENOVATION

SITE PLAN FOR DEMOLITION PHASE OF CONSTRUCTION

BRIANNE KYLE
CONSTRUCTION MANAGEMENT

OCTOBER 28, 2011





Appendix G: Site Plan for MEP/Finishes Phase of Construction

RIVER VUE APARTMENTS RENOVATION

SITE PLAN FOR MEP/FINISHES PHASE OF CONSTRUCTION

BRIANNE KYLE
CONSTRUCTION MANAGEMENT

OCTOBER 28, 2011

LEGEND

SYMBOLS:

- CONSTRUCTION GATE  GATE
- REMOVABLE PANELS 
- CONSTRUCTION FENCE 
- DUQUESNE LIGHT COMPANY VAULT (DLCO) 
- EXISTING ELEVATOR 7 TO BE USED FOR TRASH CHUTE 
- TEMPORARY TOILETS 
- FIRE HYDRANT 
- TRUCK CRANE 
- VEHICULAR TRAFFIC 

