Technical Report No. 2

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SILVERADO
AT HOME • SENIOR LIVING • HOSPICE

BUILDERS Hunzinger SINCE 1907

CAMERON MIKKELSON

The Pennsylvania State University
Department of Architectural Engineering
Construction Management

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Advisor: Dr. Ed Gannon

EXECUTIVE SUMMARY

Technical Report 2 analyzed the major components that composed project execution for Silverado Senior Living. Many different mechanisms influence how a project is run from conception to substantial completion. In this report, the efficacy of the schedule, detailed estimates, site layout planning, general conditions, constructability challenges, and Building Information Modeling (BIM) was critiqued and evaluated.

The assisted living/memory care home began construction September of 2012. Completed in September of 2013, this project was broken up into several phases ranging from design to ultimately the final interior construction. Due to strict civil design requirements, and the owners desire to complete the project before the following winter, sitework was the primary initial focus. Once finished, the building was divided up into four quadrants (A, B, C, and D). Starting with quadrant B in the south east corner, typical construction processes followed a clockwise pattern until the work was completed in quadrant A.

Because of high standards set by the owner, Silverado implemented premier HVAC and lighting systems within the facility. Detailed estimates of all MEP systems and the building structure broke down the major costs involved in the construction process. The total MEP estimate, which included fire protection, came out to a total of $2,166,696 which equals $47.91/SF and 28% of the total building cost. The structural estimate totaled $1,005,300 which comes out to $22.22/SF.

Site layout plans were developed for three major phases which included: excavation, truss installation, and MEP finishes. Although the excavation phase was critical for avoiding future problems from flooding and other environmental issues, truss installation and MEP finishes phases required more coordination between Hunzinger and the subcontractors involved with those processes. This collaboration was vital in ensuring the project was executed on time, under budget, and without injury.

As with the construction of any structure, constructability challenges were addressed before the physical construction to avoid potential delays or issues in the field. The initial focus was directed toward the civil phase of the project. Once Hunzinger fashioned a solution for sitework, then they addressed issues regarding pouring concrete in the winter and installing the roof top MEP equipment on the interior portion of the building.

An important aspect of developing an estimate for this project was the general conditions. This includes all of the supporting facilities and other work that expedite

the construction process. The general conditions estimate included elements such as a staffing plan, insurance fees, permits, bonding, temporary facilities and utilities.

Another supporting feature that has grown substantially in the construction industry is the implementation of BIM into the construction process. Hunzinger integrated this technology into Silverado through cost estimation software during the design development and construction document phases. Weekly budgets that were developed using third-party software gave the owner a comprehensive indication of what amenities were feasible and cost effective. 3D coordination via clash detection also significantly reduced field conflicts and, ultimately, completed the assisted living facility on time so the residents could move into their new home. The following report goes into thorough detail regarding all of the major process that went into construction of the Silverado Senior Living

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DETAILED PROJECT SCHEDULE

The project summary schedule in Technical Report One showed the milestones and durations of significant activities for Silverado. A detailed project schedule was developed to show duration for each major trade. The main components of the schedule are Preconstruction, Material Procurement, Sitework, Building Structure, Interior Construction, and Landscaping. Sitework was further broken up into phase 1, phase 2, and parking lot. Important dates and durations of critical phases are displayed in the figure below. The complete detailed schedule can be viewed in Appendix A.

Critical Phases			
Activity	**Duration**	**Start**	**Finish**
Design & Preconstruction	171	5/29/2012	1/7/2013
Material Procurement	52	1/4/2013	2/25/2013
Sitework	75	9/6/2012	11/20/2012
Pond & Storm Sewer	30	9/26/2012	10/26/2012
Structure	171	10/14/2012	1/2/2013
Foundation	78	10/14/2012	1/2/2013
Slab on Grade	79	12/12/2012	3/1/2013
Interior & Exterior Wall Panels	38	2/4/2013	3/12/2013
Roof Trusses	49	2/14/2013	4/2/2013
Building Envelope	147	3/14/2013	8/6/2013
Interior	179	3/6/2013	9/2/2013
MEP Rough-In	117	3/6/2013	6/21/2013
Finishes	57	6/17/2013	8/12/2013
Landscaping	112	5/9/2013	8/30/2013

Figure 1 – Summary of Critical Phases

PRECONSTRUCTION AND DESIGN

The design and preconstruction phase of this project was import because the civil work was a priority. The facility needed to be complete before the following winter so residents could move in and become acquainted before the cold winter weather set in. Hunzinger obtained an early work permit for the civil work before the final construction documents were finished. This ensured the property would drain properly as well as accommodate any water runoff from the adjacent properties. The final portion of this phase was to install the parking lot, which would provide parking for workers as well as reduce the amount of dirt and mud when the spring rains hit.

MATERIAL AND PROCUREMENT

This was a critical phase because it ensured that all long lead items would arrive on time. Both the trusses and interior/exterior wall panels were shop fabricated, so it was important to make sure these arrived to the site on time. Also, meeting the deadline was vital because Hunzinger would need to rent a crane to set the wall panels and wood trusses.

SITEWORK

Sitework was one of the most important phases in this project because completing it before the asphalt plants closed was critical. Also, the City of Brookfield required the two storm sewers be put in before the rest of the construction process could begin. The property needed to drain from the north to the southeast corner, so any additional water run-off would drain into the detention and retention ponds. Another important aspect of this phase was stripping and stockpiling the topsoil as well the final grading. No topsoil or fill dirt was hauled away on this project, so the final grade needed to be able to use all of the fill material and still meet the City of Brookfield's requirements.

BUILDING STRUCTURE

Foundation

The foundation phase of this project consisted of the pouring concrete footings and erecting the CMU foundation walls. These were constructed from mid-October to January 2nd. This was an important phase because the SOG was scheduled to be poured after this stage was completed.

Slab on Grade

This was one of the most important phases and was one of the reasons the sitework was completed first. First, first all under-slab plumbing and electrical rough-in were coordinated and completed by the respective contractors. Then the slab was poured under a heated enclosure one section at a time. Although much more time consuming than pouring during the warmer months, this allowed for the superstructure to begin before the snow thawed and the job site became messy. Once the slab was poured in quadrant B, then the wall panels could be erected.

Interior/Exterior Wall Panels

This was a critical phase because the wall panels were all shop fabricated and would eventually carry much of the load from the building. This was sequenced so once the wall panels were set in a part quadrant A and quadrant B, then the trusses could be set in the same order. These provided much of the structure so once these were up, then the roofers could begin to enclose the building as the trusses and roof sheathing was completed. It is important to note that a portion of quadrant A near the northeast corner was left open to allow for the installation of the rooftop mechanical equipment. The wall panels were delivered to the project in four shipments and followed the quadrant B to C to D to A pattern.

Roof Trusses

This phase consisted of setting the shop fabricated wooden trussed starting with the small portion of quadrant A located between the opening in the building perimeter and quadrant B. The trusses were then set in a clockwise direction and followed the installation of the interior and exterior wall panels. The trusses were shipped in two deliveries. The first went to quadrant B, and the second went to Quadrant C on the opposite side of the building.

BUILDING ENVELOPE

This phase consisted of installing the asphalt roofing, all exterior siding and trim, natural thin veneer stone, and enclosing the opening in the building perimeter. Once this phase was completed and the building was water tight, then interior work could begin.

INTERIOR

MEP Rough-In

This phase included the rough in of all mechanical, plumbing, electrical, and fire protection systems. Electrical was roughed in first and then followed by the dry pipe sprinkler system in the attic. Then HVAC started several weeks later and gas and plumbing followed. This needed to occur before the drywall could be installed and walls could be insulated.

Finishes

This phase included all MEP finishes as well painting, flooring, and other final interior work. This was the busiest time of the project because of the large number subcontractors on site. Coordination and safety is critical during this time so trades stay out of each other's way which avoids delays and other problems.

Landscaping

This was the last major section of the schedule, but did not require nearly as much coordination. After that, then landscaping the exterior of the facility could begin and move at its own pace. Most of this work included the following:

- Sidewalks and stoops
- Top soiling
- Planting trees and shrubs
- Decorative fences
- Building the courtyard gazebo and putting green
- Courtyard paths
- Exterior site lighting
- Concrete stoop and asphalt binder repairs

DETAILED STRUCTURAL ESTIMATE & ASSEMBLIES

ASSEMBLIES ESTIMATE

MEP Assemblies Estimate						
Description	Material	Installation	Total	Cost/SF	Actual Total	Actual Cost/SF
HVAC	$383,277	$242,092	$625,369	$13.83	$576,000	$12.73
Plumbing	$249,695	$166,771	$416,465	$9.21	$317,171	$7.01
Electrical	$416,955	$403,125	$820,080	$18.13	$760,746	$16.82
Fire Protection	$128,698	$176,084	$304,782	$6.74	$211,512	$4.68
Total	$1,178,625	$988,072	$2,166,696	$47.91	$1,865,429	$41.24

Figure 2 – MEP Assemblies Estimate Summary for Technical Report 2

HVAC

Silverado is composed of a split system that utilizes gas-powered packaged roof top units (RTU's) as well as gas packaged terminal air conditioners (PTAC). The building is divided up into two sections for HVAC. Spaces on the exterior portion of the facility are served by the RTU's that are placed in each of the four quadrants. The interior rooms are served by PTACs which are installed in the walls of each space. Silverado utilizes Variable Air Volume with electric reheat for multiple zones.

The total assemblies estimate for HVAC totaled $625,369 which is $13.83/SF. The majority of this number is derived from the RTU's, ductwork, and the PTAC's. The prices derived from RS MEANS were for cooling only. Ducts, diffusers, grills, and other distribution equipment were also included in the total cost of the system. The cost for the PTAC's was provided by Hunzinger and includes all piping in the total cost.

$13.83/SF is much higher than the square foot estimate of $5.09/SF in Technical Report 1 due to the fact that RS Means assumed that the mechanical system was a constant volume system with package A/C units. In reality, Silverado's VAV split system with five RTUs and gas PTAC was much more complex and costly. However, the actual system will have better life cycle energy savings in the long run than a constant volume system.

Hunzinger's number of $12.73 is slightly lower than the estimated $13.83/SF due to overlaps in scope that are reflected in the RS Means assemblies estimate. Silverado uses a split system which incorporates components from multiple systems

and because RS Means was used for this estimate, eliminating redundant features was difficult to separate from the total assemblies cost. Details for the HVAC estimate can be found in Appendix B.

Plumbing

The majority of the plumbing costs come from the bathrooms for each sleeping unit plus several other restrooms around the facility. Showers are also a significant portion of the total plumbing expenses. A typical bathroom in each sleeping unit consisted of a shower, sink, and water closet. Costs included in this estimate was all steel piping, copper tubing, waste and vent rough-in, fittings, and installation costs. It was assumed that all bathrooms were one wall plumbing and shared a common wall with another bathroom. Other plumbing costs came from the single and double bowl sinks located throughout the building. These were considered either stainless steel double bowl or steel enameled single bowl fixtures.

Total plumbing costs were estimated to be roughly $416,465 which is $9.21/SF. This was slightly higher than Hunzinger's estimate due to the fact the showers were taken off in a separate package than the water closet and sinks, which meant that rates were slightly higher due to minor redundancies in scope.

$9.21/SF was less than the square foot estimate of $12.56/SF from Technical Report One. This discrepancy is most likely from RS Means over estimating the number of plumbing fixtures in Silverado. Quality was a major focus for the owner so instead of overcrowding the facility, they concentrated on incorporating larger and more comfortable sleeping units. This resulted in a lower number of fixtures and subsequently less water distribution materials. Details for the plumbing estimate for Technical Report Two can be found in Appendix B.

Electrical

The total estimated electrical system cost totaled $820,080 which was $18.13/SF. Primary components of the electrical system consisted of the following:

- Underground electric service to the Main Switchboard
- Branch Panels
- Receptacles
- Motor Installation
- Light fixtures
- Telephone system
- Fire detection system

$18.13/SF was slightly higher than Hunzinger's number of $16.82/SF, and significantly higher than RS Means square foot estimate from Technical report 1 of

$16.30/SF. RS Means underestimated the size of main switchboard by 1000 A, which accounted for some of the difference. Overall, the projected total cost for the electrical system was very close to Hunzinger's number. Details for the electrical system estimate can be found in Appendix B.

Fire Protection

The estimated total for the protection system came out to $304,782 which is $6.74/SF. Silverado incorporates a light hazard, quick response wet-pipe sprinkler system in the occupiable spaces and a dry-pipe system for the attic. Both use steel piping for water distribution.

$6.74/SF is higher than both Hunzinger's total of $4.68, as well as the number from the square foot estimate of $3.74. This is due to the fact that Silverado uses both a wet-pipe and dry-pipe sprinkler system, and the data in RS Mean assemblies assumes that these are the only system used. When both systems were factored into the assemblies estimate, the number came out much higher than both the actual cost and the number from the square foot estimate. Also, in the square foot estimate RS Means assumes that the wet-pipe sprinkler system only covers 10,000 SF instead of the total area of the building. Details for the fire protection estimate can be found in Appendix B.

*All figures for the MEP assemblies estimate, except when noted otherwise, were derived from RS MEANS 2013

DETAILED STRUCTURAL ESTIMATE

The detailed estimate for the wood frame structure and foundation totaled $1,005,300 which came out to roughly $22.22/SF. The estimate was calculated by taking off one of the four quadrants and then multiplying those totals by four. Quadrant B had a slightly larger area than the others so a 1.25 multiplier was applied for that quadrant.

The structure for Silverado was composed of a concrete foundation which included strip footings, columns, piers, slab of grade, and load bearing concrete block foundation wall. The superstructure was composed of shop fabricated structural panels and wood trusses. The roof load is supported by load bearing shear walls that separate the sleeping units for the residents. A large portion of this estimate is derived from the sheathing that is applied to the walls and trusses.

Assumptions for the estimate included that the CMU wall was continuously 4 feet in height. No forming costs were included in the total. 20% was added to labor rate for walls to account for applying the sheathing. All headers were assumed to 2" by 8" and pneumatically nailed. Details for the structural estimate can be found in Appendix B.

Detailed Structural Estimate	
Material	$434,800.00
Labor	$218,500.00
Equipment	$352,000.00
Total	$1,005,300.00

Figure 3 – Summary of Detailed Structural Estimate

*All cost data was taken from RS Means Facilities Construction Cost Data 2013

SITE LAYOUT PLANNING

Excavation

For this phase, the most critical task was the development of the construction sediment basin, located on the south of the lot, and the temporary diversion swales. The temporary sediment basin would ultimately become the detention pond. The property has to accommodate the storm water run-off from the adjacent lots to the north and north-east, so it was paramount to have completed. Also it was important to be aware of the close proximity of the water and sewer mains on the east side of the property even though excavation did not interfere with either utility main. Another major portion of this phase was stockpiling the topsoil so it could be reused. No hauling of topsoil or fill dirt occurred on this project, so any extra ground material was used to create the final grade which drained from the north to the south end of the property. During this phase of the project, workers were directed to park in St. Luke's Church if needed. Limits of disturbance are marked with the red dashed line and are primarily on the west, north, and east sides of the lot. The site layout used by Hunzinger was effective because it focused on reusing fill material as well as topsoil so hauling excess material was needed. Also the civil work was the primary focus at this point, so most efforts were directed at meeting the storm water run-off and final grade requirements. Once this was complete, then the parking lot could be installed and the foundation and footings could be poured. A site layout plan for this phase can be seen in Appendix C.

Figure 4 – Detention Pond **Courtesy of Hunzinger**

Roof Truss and SOG

The building was split up into four quadrants, and followed a B to C to D to A pattern. In this phase, the slab on grade was being poured in quad D under an enclosure to protect it from the winter conditions. While this was occurring, the shop fabricated roof trusses were being installed in quadrant B. This allowed these two

trades to work without interfering with one another. Truss storage and crane pick locations were located on the east side of the project near Davidson Rd. Concrete staging was on the opposite (west) side of the property next to the residential lots. Because the building surrounds a courtyard, a portion of quadrant B was left open so materials and equipment could be moved to the interior portions of the building. Also, at this point in construction, the slab has not been poured in quadrant A.

Figure 5 – Roof Truss Construction **Courtesy of Hunzinger**

This was an appropriate site layout for this phase of the project because it expedited the schedule by allowing both concrete to be poured and trusses to be set at the same time. Concrete trucks could access quadrant D without interfering with setting the roof trusses. Hunzinger took advantage of a relatively open site and used it to stage the large, shop-fabricated roof trusses one quadrant at time. The focus of this phase was pouring the concrete in the cold winter conditions. This took added effort to ensure the ground was thawed and the concrete had time to cure at the required temperature and humidity levels. By pouring the slab on grade in winter, Hunzinger was ultimately able to save several months in schedule and reach occupancy in the following September. Site layout details for this phase are located in Appendix C.

MEP Finishes Phase

This phase required more coordination than the excavation and SOG/Roof Truss phases because of the large number of subcontractors involved. The opening in quadrant B to the courtyard was closed by this point. Many different subcontractors were on-site during this phase, so it was critical to keep them from interfering with each other. Each sub was allowed to stage materials in their respective quadrants which meant they could easily access their building supplies. Electrical and HVAC finishes were working in quadrant A. Behind them was case work and floor/carpet installation in quadrant D. Plumbing finishes was halfway through their work in quadrant C and painting finishes had just begun in quadrant B.

The most critical aspect of this phase was managing the subcontractors in a manner that was efficient and reduced complications in the field. Staging for each trade in their respective locations was critical because many would need to frequently move materials in and out of the building. Also, dumpsters were located by each quadrant to help keep the site clear of waste materials. A site layout for this phase can be seen in Appendix C.

Figure 6 – Interior Light Fixture Installation

CONSTRUCTABILITY CHALLENGES

CIVIL AND UTILITY WORK

In order to reach building turnover in September of 2013, Hunzinger had to gain approval from the city of Brookfield, WI, to obtain an early work permit for the civil portion of the project. Silverado would not be allowed to build on the property unless they accommodated the storm water run-off from the adjacent lots to the north and northeast. This meant that to avoid problems arising from rainy spring weather and subsequently muddy jobsite, the civil work needed to begin in the fall of 2012.

Originally, the lot was a field that allowed water run-off to drain to the southern portion of the lot. Since the prospective senior living facility would interfere with the natural slope of the property, two temporary diversion swales had to be installed during the Phase 1 of grading and erosion control. These drained into a temporary construction sediment basin which would ultimately turn into the permanent detention pond.

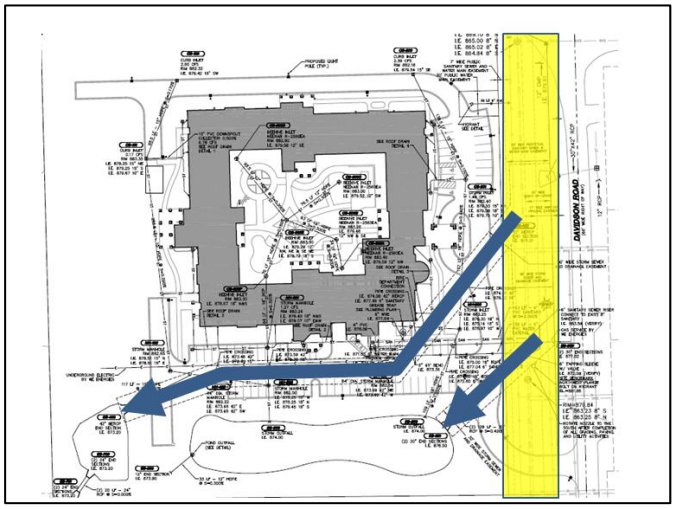


Figure 7 – Storm Sewer Location

Once the property was graded according to plan, two storm sewers had to be put in to allow the water run-off to drain into the detention and retention ponds. These are illustrated by the blue arrows in the figure above. All water discharge needed to be directed toward the southwest corner of the site. Both ponds were designed to withstand 100 year storms. The image to right shows the primary storm sewer leading into the detention pond.

Figure 8 – Primary Storm Sewer **Courtesy of Hunzinger**

Pouring the Slab on Grade

In addition to completing the civil work first, the slab on grade needed to be poured during the winter in order to maintain the desired schedule and avoid a muddy jobsite in the spring. Because of the harsh winter conditions in Wisconsin, this meant that extra measures were taken to ensure the concrete work was done correctly. All snow, ice, and frost needed to be removed from the surface and the subgrade was then thawed under the temporary enclosures that were furnished by Hunzinger who self-performed all of the concrete work.

One section was poured under one enclosure at a time, while the next section was being thawed. The typical process involved delivery by truck and ultimately placed in the correct location by buggy. Once the entire section was poured, the tent would remain for an additional two days to allow the concrete to cure and protect it from freezing. Hunzinger used heaters to maintain the temperature inside the tent and vented flue gases to the outside of the enclosure.

Figure 9 – Cold Weather Concrete Placement **Courtesy of Hunzinger**

Interior Courtyard

The Silverado Senior Living Facility contained an interior courtyard by design which meant that there was a façade on the exterior side of the building as well a façade on the inner portion. In order to get materials to the interior façade, a section of quadrant A was left open. This allowed the equipment and supplies to be moved from staging to final installation locations without disturbing interior construction in the rest of the project. Also, because the major mechanical equipment was located on interior portion of the roof, leaving an opening made installation much simpler.

Sleeping unit facing the courtyard were served PTAC's, which were delivered to their final locations through the opening as well. The courtyard also contained trees, a pavilion, and a putting green, so it was much easier to move equipment and materials through the opening than to plant the trees when it was still too cold out or drop lift them into place by crane.

Figure 10 – Opening Leading to Courtyard in Quad A **Courtesy of Hunzinger**

GENERAL CONDITIONS ESTIMATE

The General Conditions Estimate was performs using a combination of RSMeans CostWorks data as well as provided rates from Hunzinger. The total amount for the General Conditions came out to approximately $806,000 for the project. This included Management and Staffing, Temporary Utilities, Equipment and Facilities, and Insurance, Bonding, and Permits. The table below summarizes the General Conditions Costs. It is important to note the winter conditions expenses, which totaled $175,000, were not included in the total estimate.

Description	Amount
Management and Staffing	$447,080.00
Temporary Utilities	$29,700.00
Equipment and Facilities	$123,454.00
Insurace, Permits, and Bonding	$205,537.66
Total	**$805,771.66**

Figure 11 – Summary of General Conditions Estimate

Management and Staffing

Management and Staffing included all personnel involved on the project. The roles of Senior Project Manager, Senior Estimator, and Superintendent were considered at 40 hours per week. Project Executive was allotted eight hours per week and Safety Officer and General Superintendent were allotted four hours per week. This varied from Tech 1 staffing plan due to newfound information regarding the involvement of a general superintendent and safety officer.

Temporary Utilities

Temporary Utilities was composed of all landline, internet, and cell phones for the project team. Also, temporary toilets, water, heat/propane, and temporary electric power were added into the total.

Equipment and Facilities

Equipment and Facilities included the following:

- Site Trailer
- Office Supplies and Equipment
- Safety Expenses
- Waste Disposal
- Weekly Cleaning
- Jobsite Tools
- Trucking and Fuel Expenses
- Site Signage
- Postage and Courier Expenses

Insurance, Permits, and Bonding

Insurance, Permits, and Bonding amounts were developed based on a percentage of the total project cost. Insurance for the project was Builders (All) Risk and was 0.45% of the total project cost. Performance Bonding was 1.5% and Permitting costs were 0.75% of the job. In the actual General Conditions budget for the project, this section was broken out as separate expenses.

*General Conditions estimate details can be found in Appendix D.

BUILDING INFORMATION MODELING USE EVALUATION

Silverado Properties' primary focus for this project was to drive the schedule so that prospective residents could move into the facility as soon as possible while maintaining the high quality final product desired by the owners. This was accomplished through the use of cost estimation software during the schematic, design development and construction document phases. Hunzinger and Eppstein Uhen, the architect, held weekly meetings that developed weekly building models and budgets which ultimately created a design and construction plan to maximize efficiency, quality, and owner satisfaction. The project team frequently evaluated alternate mechanical systems and created multiple budgets in order to determining the most cost effective means to achieve the owner's goals. They focused on MEP coordination, and phase planning to expedite the design and construction process and increase the final quality of the building. BIM was utilized more in the early stages of the project with the development of various budgets and clash detection which determined the most cost effective design that still met the owner's goals.

Potential BIM Uses

BIM objectives for this project are listed in the table below. Uses for the project could include site analysis because of the proximity to large sanitary and water mains, site analysis was important in the schematic design phase of this project. Civil work was a major aspect of this project and site analysis would prove helpful in completing this phase. Because of the repetitive nature of building a senior living facility, 4D modeling could be utilized to show the work sequence involved for each quadrant. The building contained an interior courtyard, which meant a section of the quadrant A was left out in order to allow for the installment of rooftop mechanical equipment as well as other landscaping purposes.

Priority (1-3)	Goal Description	Potential BIM Uses
High	Develop frequent budgets to analyze alternate engineering systems during design phase	Use of cost loaded schedules and man hour curves
Med	Implement trade sequencing and track progress	Trade coordination
Med	Evaluate feasibilty and profitabilty of self performed work	Develop frequent budgets with current information
High	Provide facitly managers with accurate electronic maintenace and operation manuals	Record modeling and transfer of information

Figure 12 – BIM use objectives

Since Silverado combines residential construction with various health care characteristics, record modeling would be helpful because it would provide the owner with an accurate electronic model of the facility. Silverado has been successful with all of their other locations, so there is great possibility that at some point the owner would want to expand. Record modeling would help them add on to the existing structure, as well help them fix any issues they may have with the facility. A building maintenance schedule would also prove useful. In a facility with a lot of operational equipment such as an assisted living facility, a maintenance schedule would allow building manager to quickly troubleshoot any problems that arise. A level one process map, located in Appendix E.

X	PLAN	X	DESIGN	X	CONSTRUCT	X	OPERATE
	Programming		Design Authoring		Construction System Design	X	Building Maintenace Schedule
X	Site Analysis	X	Design Reviews	X	Site Utilization Planning	X	Building System Analysis
		X	3D Coordination	X	3D Coordintation		Asset Management
		X	Structural Analysis				
		X	Lighting Analysis				
			Energy Analysis				
		X	Mechanical Analysis				
			Other Engineering Analysis		Digital Fabrication		Space Management
			Sustainability Evaluation		3D Control and Planning		Disaster Planning
			Code Validation		Record Modeling	X	Record Modeling
	Phase Planning	X	Phase Planning	X	Phase Planning		Phase Planning
X	Cost Estimation	X	Cost Estimation		Cost Estimation		Cost Estimation
	Existing Conditions Modeling		Existing Conditions Modeling		Existing Conditions Modeling		Existing Conditions Modeling

Figure 13 – BIM use matrix

Critical Evaluation

Silverado was not an overly complex project in terms of design and construction of the facility. BIM was used appropriately on this project and met all of the owner's needs without causing extra work for the project team and subcontractors. Cost estimation was the most important because it gave the owner a rough figure of what the potential building would cost, and if Silverado could pursue additional amenities and stay within budget. The weekly meeting maintained active communication between Hunzinger, architect, and MEP engineer. Also, engineering analysis was critical in determining the best mechanical and lighting systems for the facility. Due to the highly sensitive residents to air quality and especially lighting, the owner had very specific demands in regards to air quality and lighting for the

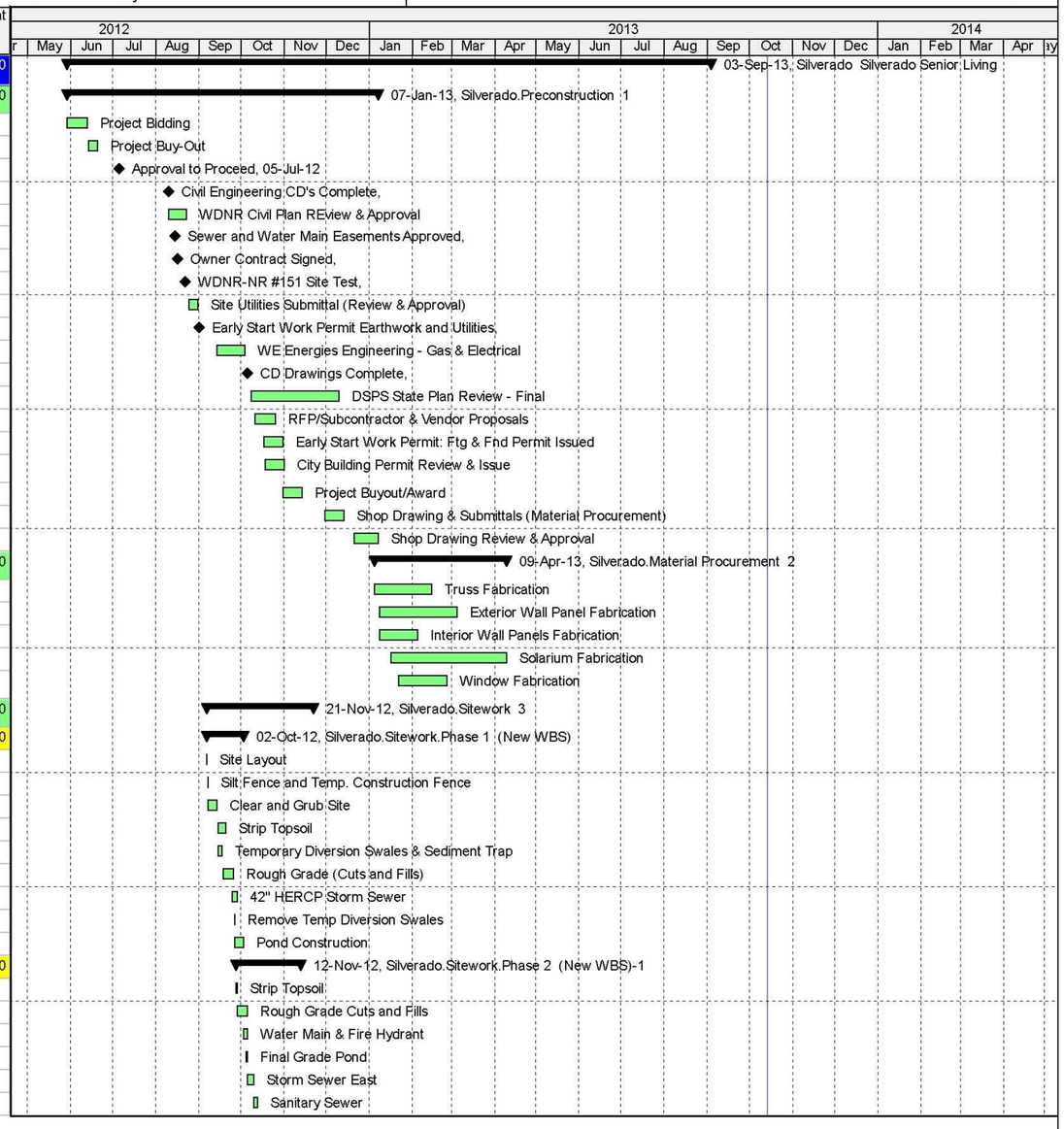
building. The MEP engineer was required to develop multiple alternates for both systems, which allowed Hunzinger to then create multiple budgets until they reached a final agreeable design.

APPENDIX A

DETAILED PROJECT SCHEDULE

Silverado Senior Living | Classic Schedule Layout | 14-Oct-13 20:49

Activity Name	Original Duration	Start	Finish	Total Float
Silverado Silverado Senior Living	323	29-May-12	03-Sep-13	0
Silverado.Preconstruction 1	155	29-May-12	07-Jan-13	0
Project Bidding	11	29-May-12	12-Jun-12	
Project Buy-Out	5	13-Jun-12	19-Jun-12	
Approval to Proceed	0	05-Jul-12		
Civil Engineering CD's Complete	0		09-Aug-12	
WDNR Civil Plan REview & Approval	9	10-Aug-12	22-Aug-12	
Sewer and Water Main Easements Approved	0		14-Aug-12	
Owner Contract Signed	0		16-Aug-12	
WDNR-NR #151 Site Test	0		21-Aug-12	
Site Utilities Submittal (Review & Approval)	5	24-Aug-12	30-Aug-12	
Early Start Work Permit Earthwork and Utilities	0		31-Aug-12	
WE Energies Engineering - Gas & Electrical	15	13-Sep-12	03-Oct-12	
CD Drawings Complete	0		05-Oct-12	
DSPS State Plan Review - Final	45	08-Oct-12	10-Dec-12	
RFP/Subcontractor & Vendor Proposals	11	11-Oct-12	25-Oct-12	
Early Start Work Permit: Ftg & Fnd Permit Issued	10	17-Oct-12	30-Oct-12	
City Building Permit Review & Issue	10	18-Oct-12	31-Oct-12	
Project Buyout/Award	10	31-Oct-12	13-Nov-12	
Shop Drawing & Submittals (Material Procurement)	10	30-Nov-12	13-Dec-12	
Shop Drawing Review & Approval	10	21-Dec-12	07-Jan-13	
Silverado.Material Procurement 2	68	04-Jan-13	09-Apr-13	0
Truss Fabrication	30	04-Jan-13	14-Feb-13	
Exterior Wall Panel Fabrication	40	08-Jan-13	04-Mar-13	
Interior Wall Panels Fabrication	20	08-Jan-13	04-Feb-13	
Solarium Fabrication	60	16-Jan-13	09-Apr-13	
Window Fabrication	25	22-Jan-13	25-Feb-13	
Silverado.Sitework 3	55	06-Sep-12	21-Nov-12	0
Silverado.Sitework.Phase 1 (New WBS)	19	06-Sep-12	02-Oct-12	0
Site Layout	1	06-Sep-12	06-Sep-12	
Silt Fence and Temp. Construction Fence	1	07-Sep-12	07-Sep-12	
Clear and Grub Site	5	07-Sep-12	13-Sep-12	
Strip Topsoil	4	14-Sep-12	19-Sep-12	
Temporary Diversion Swales & Sediment Trap	2	14-Sep-12	17-Sep-12	
Rough Grade (Cuts and Fills)	6	18-Sep-12	25-Sep-12	
42" HERCP Storm Sewer	5	24-Sep-12	28-Sep-12	
Remove Temp Diversion Swales	1	26-Sep-12	26-Sep-12	
Pond Construction	5	26-Sep-12	02-Oct-12	
Silverado.Sitework.Phase 2 (New WBS)-1	33	27-Sep-12	12-Nov-12	0
Strip Topsoil	2	27-Sep-12	28-Sep-12	
Rough Grade Cuts and Fills	6	28-Sep-12	05-Oct-12	
Water Main & Fire Hydrant	4	02-Oct-12	05-Oct-12	
Final Grade Pond	2	04-Oct-12	05-Oct-12	
Storm Sewer East	3	05-Oct-12	09-Oct-12	
Sanitary Sewer	3	10-Oct-12	12-Oct-12	



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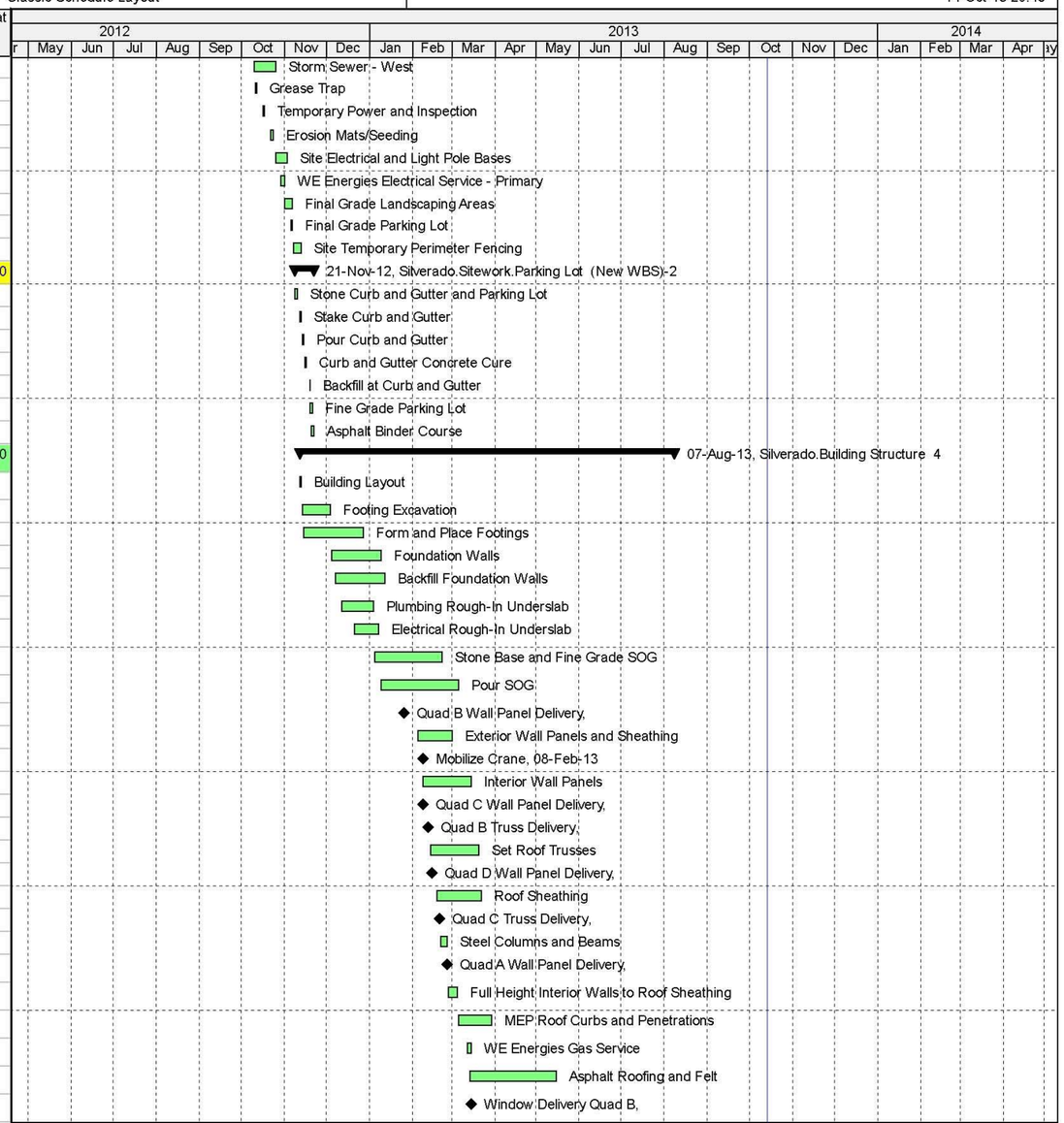
Activity Name	Original Duration	Start	Finish	Total Float
Storm Sewer - West	12	10-Oct-12	25-Oct-12	
Grease Trap	1	11-Oct-12	11-Oct-12	
Temporary Power and Inspection	2	16-Oct-12	17-Oct-12	
Erosion Mats/Seeding	2	22-Oct-12	23-Oct-12	
Site Electrical and Light Pole Bases	7	25-Oct-12	02-Nov-12	
WE Energies Electrical Service - Primary	3	29-Oct-12	31-Oct-12	
Final Grade Landscaping Areas	4	01-Nov-12	06-Nov-12	
Final Grade Parking Lot	2	05-Nov-12	06-Nov-12	
Site Temporary Perimeter Fencing	4	07-Nov-12	12-Nov-12	
Silverado.Sitework.Parking Lot (New WBS)-2	10	08-Nov-12	21-Nov-12	0
Stone Curb and Gutter and Parking Lot	2	08-Nov-12	09-Nov-12	
Stake Curb and Gutter	1	12-Nov-12	12-Nov-12	
Pour Curb and Gutter	2	13-Nov-12	14-Nov-12	
Curb and Gutter Concrete Cure	2	15-Nov-12	16-Nov-12	
Backfill at Curb and Gutter	1	19-Nov-12	19-Nov-12	
Fine Grade Parking Lot	2	19-Nov-12	20-Nov-12	
Asphalt Binder Course	2	20-Nov-12	21-Nov-12	
Silverado.Building Structure 4	188	12-Nov-12	07-Aug-13	0
Building Layout	1	12-Nov-12	12-Nov-12	
Footing Excavation	14	13-Nov-12	03-Dec-12	
Form and Place Footings	30	14-Nov-12	27-Dec-12	
Foundation Walls	25	04-Dec-12	09-Jan-13	
Backfill Foundation Walls	24	07-Dec-12	11-Jan-13	
Plumbing Rough-In Underslab	15	12-Dec-12	03-Jan-13	
Electrical Rough-In Underslab	10	21-Dec-12	07-Jan-13	
Stone Base and Fine Grade SOG	35	04-Jan-13	21-Feb-13	
Pour SOG	40	09-Jan-13	05-Mar-13	
Quad B Wall Panel Delivery	0		25-Jan-13	
Exterior Wall Panels and Sheathing	20	04-Feb-13	01-Mar-13	
Mobilize Crane	0	08-Feb-13		
Interior Wall Panels	25	08-Feb-13	14-Mar-13	
Quad C Wall Panel Delivery	0		08-Feb-13	
Quad B Truss Delivery	0		11-Feb-13	
Set Roof Trusses	25	14-Feb-13	20-Mar-13	
Quad D Wall Panel Delivery	0		14-Feb-13	
Roof Sheathing	25	18-Feb-13	22-Mar-13	
Quad C Truss Delivery	0		20-Feb-13	
Steel Columns and Beams	3	21-Feb-13	25-Feb-13	
Quad A Wall Panel Delivery	0		25-Feb-13	
Full Height Interior Walls to Roof Sheathing	5	26-Feb-13	04-Mar-13	
MEP Roof Curbs and Penetrations	18	06-Mar-13	29-Mar-13	
WE Energies Gas Service	3	12-Mar-13	14-Mar-13	
Asphalt Roofing and Felt	45	14-Mar-13	15-May-13	
Window Delivery Quad B	0		14-Mar-13	



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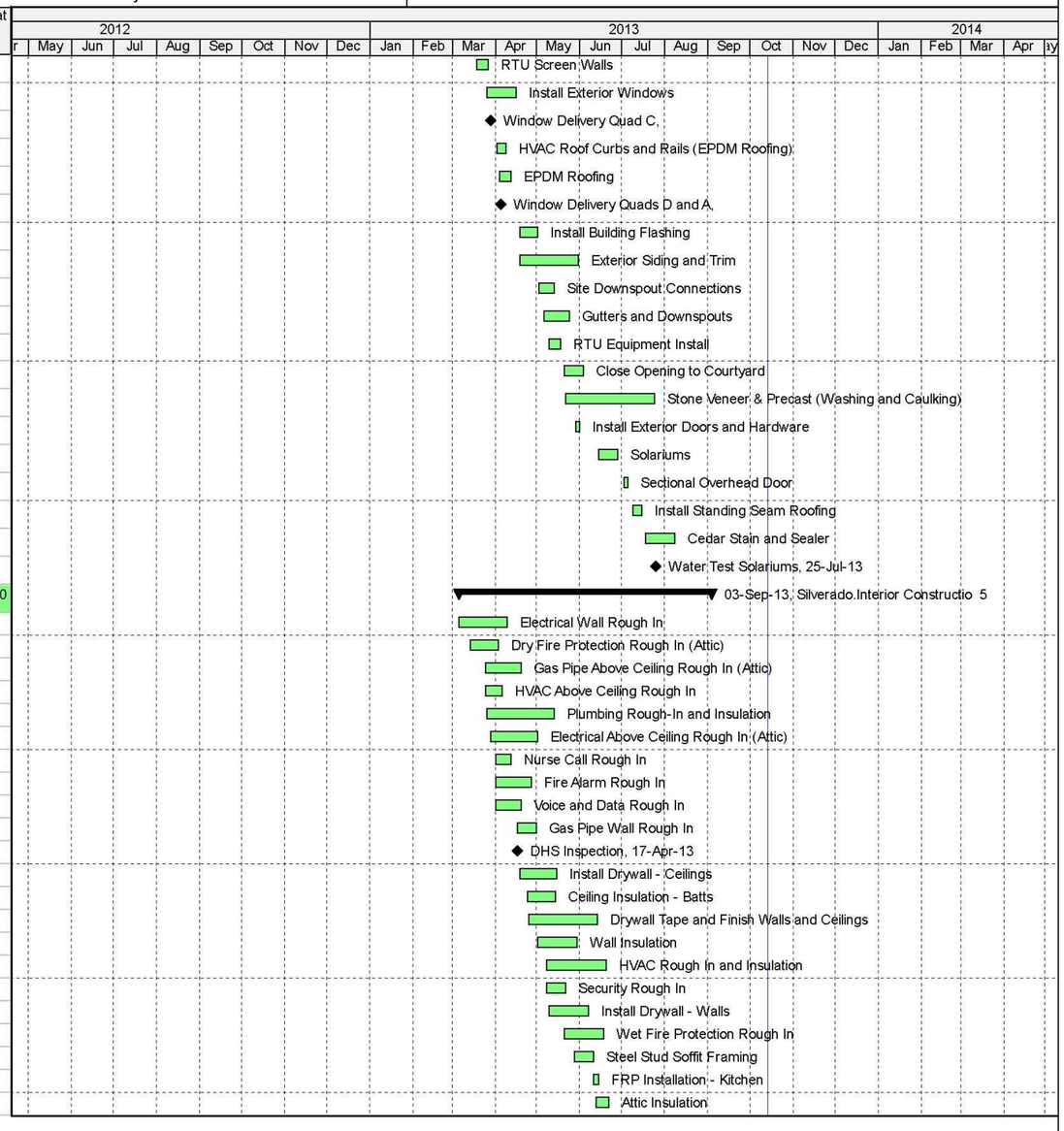
Activity Name	Original Duration	Start	Finish	Total Float
RTU Screen Walls	7	18-Mar-13	26-Mar-13	
Install Exterior Windows	15	26-Mar-13	15-Apr-13	
Window Delivery Quad C	0		28-Mar-13	
HVAC Roof Curbs and Rails (EPDM Roofing)	5	02-Apr-13	08-Apr-13	
EPDM Roofing	7	04-Apr-13	12-Apr-13	
Window Delivery Quads D and A	0		04-Apr-13	
Install Building Flashing	10	18-Apr-13	01-May-13	
Exterior Siding and Trim	30	18-Apr-13	30-May-13	
Site Downspout Connections	8	02-May-13	13-May-13	
Gutters and Downspouts	15	06-May-13	24-May-13	
RTU Equipment Install	7	09-May-13	17-May-13	
Close Opening to Courtyard	10	20-May-13	03-Jun-13	
Stone Veneer & Precast (Washing and Caulking)	45	21-May-13	24-Jul-13	
Install Exterior Doors and Hardware	3	29-May-13	31-May-13	
Solariums	10	14-Jun-13	27-Jun-13	
Sectional Overhead Door	3	02-Jul-13	05-Jul-13	
Install Standing Seam Roofing	5	09-Jul-13	15-Jul-13	
Cedar Stain and Sealer	15	18-Jul-13	07-Aug-13	
Water Test Solariums	0	25-Jul-13		
Silverado.Interior Constructio 5	127	06-Mar-13	03-Sep-13	0
Electrical Wall Rough In	25	06-Mar-13	09-Apr-13	
Dry Fire Protection Rough In (Attic)	15	14-Mar-13	03-Apr-13	
Gas Pipe Above Ceiling Rough In (Attic)	20	25-Mar-13	19-Apr-13	
HVAC Above Ceiling Rough In	10	25-Mar-13	05-Apr-13	
Plumbing Rough-In and Insulation	35	26-Mar-13	13-May-13	
Electrical Above Ceiling Rough In (Attic)	25	28-Mar-13	01-May-13	
Nurse Call Rough In	10	01-Apr-13	12-Apr-13	
Fire Alarm Rough In	20	01-Apr-13	26-Apr-13	
Voice and Data Rough In	15	01-Apr-13	19-Apr-13	
Gas Pipe Wall Rough In	10	17-Apr-13	30-Apr-13	
DHS Inspection	0	17-Apr-13		
Install Drywall - Ceilings	20	18-Apr-13	15-May-13	
Ceiling Insulation - Batts	15	24-Apr-13	14-May-13	
Drywall Tape and Finish Walls and Ceilings	35	25-Apr-13	13-Jun-13	
Wall Insulation	20	01-May-13	29-May-13	
HVAC Rough In and Insulation	30	08-May-13	19-Jun-13	
Security Rough In	10	08-May-13	21-May-13	
Install Drywall - Walls	20	09-May-13	06-Jun-13	
Wet Fire Protection Rough In	20	20-May-13	17-Jun-13	
Steel Stud Soffit Framing	10	28-May-13	10-Jun-13	
FRP Installation - Kitchen	5	10-Jun-13	14-Jun-13	
Attic Insulation	8	12-Jun-13	21-Jun-13	



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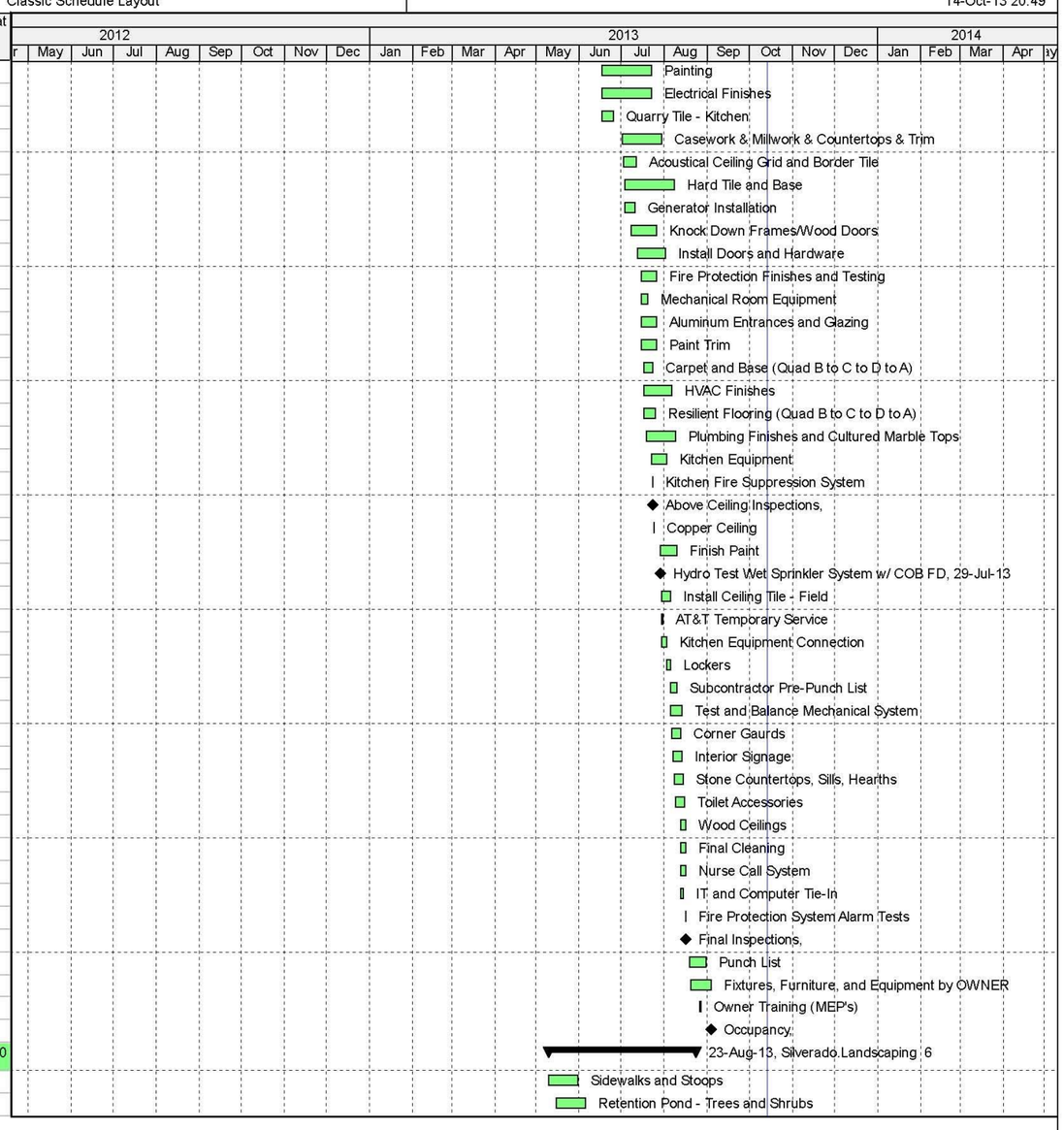
Activity Name	Original Duration	Start	Finish	Total Float
Painting	25	17-Jun-13	22-Jul-13	
Electrical Finishes	25	17-Jun-13	22-Jul-13	
Quarry Tile - Kitchen	7	17-Jun-13	25-Jun-13	
Casework & Millwork & Countertops & Trim	20	01-Jul-13	29-Jul-13	
Acoustical Ceiling Grid and Border Tile	7	02-Jul-13	11-Jul-13	
Hard Tile and Base	25	03-Jul-13	07-Aug-13	
Generator Installation	5	03-Jul-13	10-Jul-13	
Knock Down Frames/Wood Doors	15	08-Jul-13	26-Jul-13	
Install Doors and Hardware	15	12-Jul-13	01-Aug-13	
Fire Protection Finishes and Testing	10	15-Jul-13	26-Jul-13	
Mechanical Room Equipment	5	15-Jul-13	19-Jul-13	
Aluminum Entrances and Glazing	10	15-Jul-13	26-Jul-13	
Paint Trim	10	15-Jul-13	26-Jul-13	
Carpet and Base (Quad B to C to D to A)	5	17-Jul-13	23-Jul-13	
HVAC Finishes	15	17-Jul-13	06-Aug-13	
Resilient Flooring (Quad B to C to D to A)	7	17-Jul-13	25-Jul-13	
Plumbing Finishes and Cultured Marble Tops	15	19-Jul-13	08-Aug-13	
Kitchen Equipment	10	22-Jul-13	02-Aug-13	
Kitchen Fire Suppression System	1	23-Jul-13	23-Jul-13	
Above Ceiling Inspections	0		23-Jul-13	
Copper Ceiling	1	24-Jul-13	24-Jul-13	
Finish Paint	10	29-Jul-13	09-Aug-13	
Hydro Test Wet Sprinkler System w/ COB FD	0	29-Jul-13		
Install Ceiling Tile - Field	5	30-Jul-13	05-Aug-13	
AT&T Temporary Service	1	30-Jul-13	30-Jul-13	
Kitchen Equipment Connection	4	30-Jul-13	02-Aug-13	
Lockers	2	02-Aug-13	05-Aug-13	
Subcontractor Pre-Punch List	5	05-Aug-13	09-Aug-13	
Test and Balance Mechanical System	7	05-Aug-13	13-Aug-13	
Corner Gaurds	5	06-Aug-13	12-Aug-13	
Interior Signage	5	07-Aug-13	13-Aug-13	
Stone Countertops, Sills, Hearths	5	08-Aug-13	14-Aug-13	
Toilet Accessories	5	09-Aug-13	15-Aug-13	
Wood Ceilings	5	12-Aug-13	16-Aug-13	
Final Cleaning	5	12-Aug-13	16-Aug-13	
Nurse Call System	5	12-Aug-13	16-Aug-13	
IT and Computer Tie-In	3	12-Aug-13	14-Aug-13	
Fire Protection System Alarm Tests	1	16-Aug-13	16-Aug-13	
Final Inspections	0		16-Aug-13	
Punch List	10	19-Aug-13	30-Aug-13	
Fixtures, Furniture, and Equipment by OWNER	10	20-Aug-13	03-Sep-13	
Owner Training (MEP's)	2	26-Aug-13	27-Aug-13	
Occupancy	0		03-Sep-13	
Silverado.Landscaping 6	75	09-May-13	23-Aug-13	0
Sidewalks and Stoops	15	09-May-13	30-May-13	
Retention Pond - Trees and Shrubs	15	15-May-13	05-Jun-13	



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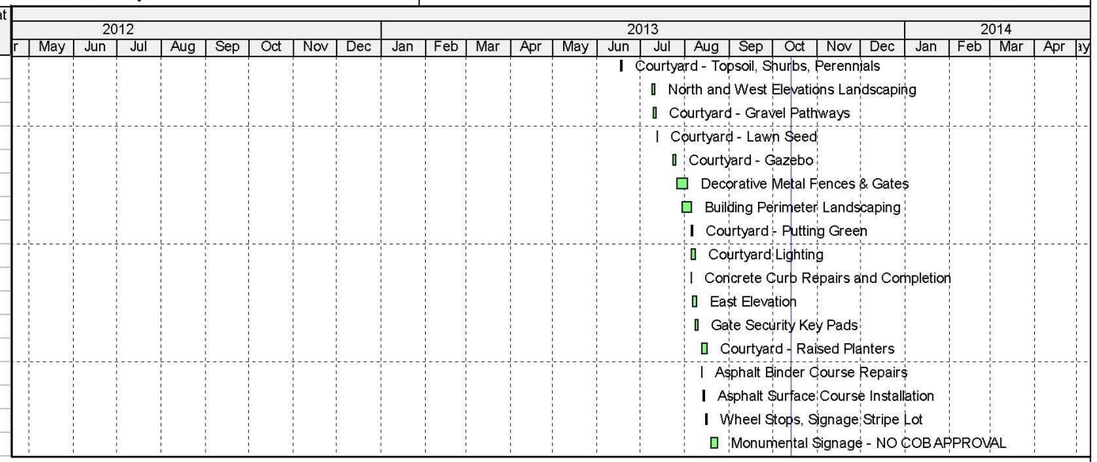
Activity Name	Original Duration	Start	Finish	Total Float
Courtyard - Topsoil, Shurbs, Perennials	1	17-Jun-13	17-Jun-13	
North and West Elevations Landscaping	2	09-Jul-13	10-Jul-13	
Courtyard - Gravel Pathways	2	10-Jul-13	11-Jul-13	
Courtyard - Lawn Seed	1	12-Jul-13	12-Jul-13	
Courtyard - Gazebo	3	23-Jul-13	25-Jul-13	
Decorative Metal Fences & Gates	6	26-Jul-13	02-Aug-13	
Building Perimeter Landscaping	5	30-Jul-13	05-Aug-13	
Courtyard - Putting Green	2	05-Aug-13	06-Aug-13	
Courtyard Lighting	3	05-Aug-13	07-Aug-13	
Concrete Curb Repairs and Completion	1	05-Aug-13	05-Aug-13	
East Elevation	3	06-Aug-13	08-Aug-13	
Gate Security Key Pads	2	08-Aug-13	09-Aug-13	
Courtyard - Raised Planters	5	12-Aug-13	16-Aug-13	
Asphalt Binder Course Repairs	1	12-Aug-13	12-Aug-13	
Asphalt Surface Course Installation	2	13-Aug-13	14-Aug-13	
Wheel Stops, Signage Stripe Lot	2	15-Aug-13	16-Aug-13	
Monumental Signage - NO COB APPROVAL	5	19-Aug-13	23-Aug-13	



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APPENDIX B

DETAILED ESTIMATE

HVAC

Item Code	Description	Qty	Unit	Material	Material Total	Installation	Installation Total	Total	Total/SF
D3050 155 1280	Rooftop, multizone unit, standard controls, curb	5	Ea.	$28,820.00	$144,100.00	$1,914.00	$9,570.00	$153,670.00	$3.40
D3050 160 1300	Ductwork package for Rooftop multizone units	1	System	$20,020.00	$20,020.00	$121,912.00	$121,912.00	$141,932.00	$3.14
D3050 160 1300	Refrigeration piping	1	System	$20,455.74	$20,455.74	$42,822.00	$42,822.00	$63,277.74	$1.40
D3050 160 1300	Condensing unit, air cooled, incls compressor and standard controls	9	Ea.	$1,494.50	$13,450.50	$610.00	$5,490.00	$18,940.50	$0.42
Provided	Gas packaged terminal air conditioning unit (Window unit)	18	Ea.	$6,734.00	$121,212.00	$1,723.00	$31,014.00	$152,226.00	$3.37
	Sub-total (location factor (104.4) applied)				$333,284.72		$220,083.55	$553,368.27	$12.23
	Misc. Material (5%)				$16,664.24			$16,664.24	
	O&P (10%)				$33,328.47		$22,008.36	$55,336.83	
	Total				$383,277.43		$242,091.91	**$625,369.34**	**$13.83**

Plumbing

Item Code	Description	Qty	Unit	Material	Material Total	Installation	Installation Total	Total	Total/SF
D2010 922 2240	Two fixture bathroom, one wall plumbing	55	Ea.	$1,450.00	$79,750.00	$1,550.00	$85,250.00	$165,000.00	$3.65
D2010 710 1640	Shower, three wall, terrazzo, molded stone receptor,	55	Ea.	$1,975.00	$108,625.00	$860.00	$47,300.00	$155,925.00	$3.45
D2010 410 1960	Stainless steel double bowl 32" x 22"	8	Ea.	$1,575	$12,600.00	$875.00	$7,000.00	$19,600.00	$0.43
D2010 410 2120	Steel, enamled, 24" x 21" single bowl	7	Ea.	1000	$7,000.00	$810.00	$5,670.00	$12,670.00	$0.28
	Sub-total (location factor (104.4) applied)				$217,125.90		$151,609.680	$368,735.58	$8.15
	Misc. Material (5%)				$10,856.30			$10,856.30	
	O&P (10%)				$21,712.59		$15,160.97	$36,873.56	
	Total				$249,694.79		$166,770.65	**$416,465.433**	**$9.21**

Electrical

Item Code	Description	Qty	Unit	Material	Material Total	Installation	Installation Total	Total	Total/SF
D5010 130 1100	Underground electric service including excavation, backfill, compaction. 3 Phase, 4 wire, 1600A, 208Y/120 Volt, 65 K.A.I.C.	1	Ea.	$34,400.00	$34,400.00	$16,700.00	$16,700.00	$51,100.00	$1.13
D5010 250 1020	Panelboard 100A, 1 story, 25' horizontal	3	Ea.	$1,700.00	$5,100.00	$1,975.00	$5,925.00	$11,025.00	$0.24
D5010 250 2000	Panelboard 225A, 1 story, 25' horizontal	9	Ea.	$3,650.00	$32,850.00	$2,875.00	$25,875.00	$58,725.00	$1.30
D5010 250 2080	Panelboard 400A, 1 story, 25' horizontal	1	Ea.	$5,175.00	$5,175.00	$4,425.00	$4,425.00	$9,600.00	$0.21
D5010 115 0760	Receptacles, Conduit system with floor boxes, high density	45,230	SF	$2.58	$116,693.40	$2.19	$99,053.70	$215,747.10	$4.77
D5010 145 0560	Motor Installation - Three phase, 200V, 3 HP	10	Ea.	$785.00	$7,850.00	$1,200.00	$12,000.00	$19,850.00	$0.44
D5010 145 0640	Motor Installation - Three Phase, 200V, 7.5 HP	5	Ea.	$885.00	$4,425.00	$1,350.00	$6,750.00	$11,175.00	$0.25
D5010 210 0500	Flourescent Firxtures, 0.8 Watt per S.F., 20 FC, 5 Fixtures @ 32 Watt per 1000 SF	45230	SF	$0.82	$37,088.60	$1.90	$85,937.00	$123,025.60	$2.72
D5010 310 0640	Telephone systems, underfloor conduit system with floor boxes, low density	45230	SF	$1.55	$70,106.50	$1.16	$52,466.80	$122,573.30	$2.71
D5030 910 0456	Fire detection system, addressable, 100 detectors	1	Ea.	$33,600.00	$33,600.00	$41,900.00	$41,900.00	$75,500.00	$1.67
	Sub-total (location factor (104.4) applied)				$362,569.19		$366,477.93	$729,047.12	$16.12
	Misc. Material (5%)				$18,128.46			$18,128.46	
	O&P (10%)				$36,256.92		$36,647.79	$72,904.71	
	Total				$416,954.57		$403,125.72	**$820,080.296**	**$18.13**

Fire Protection

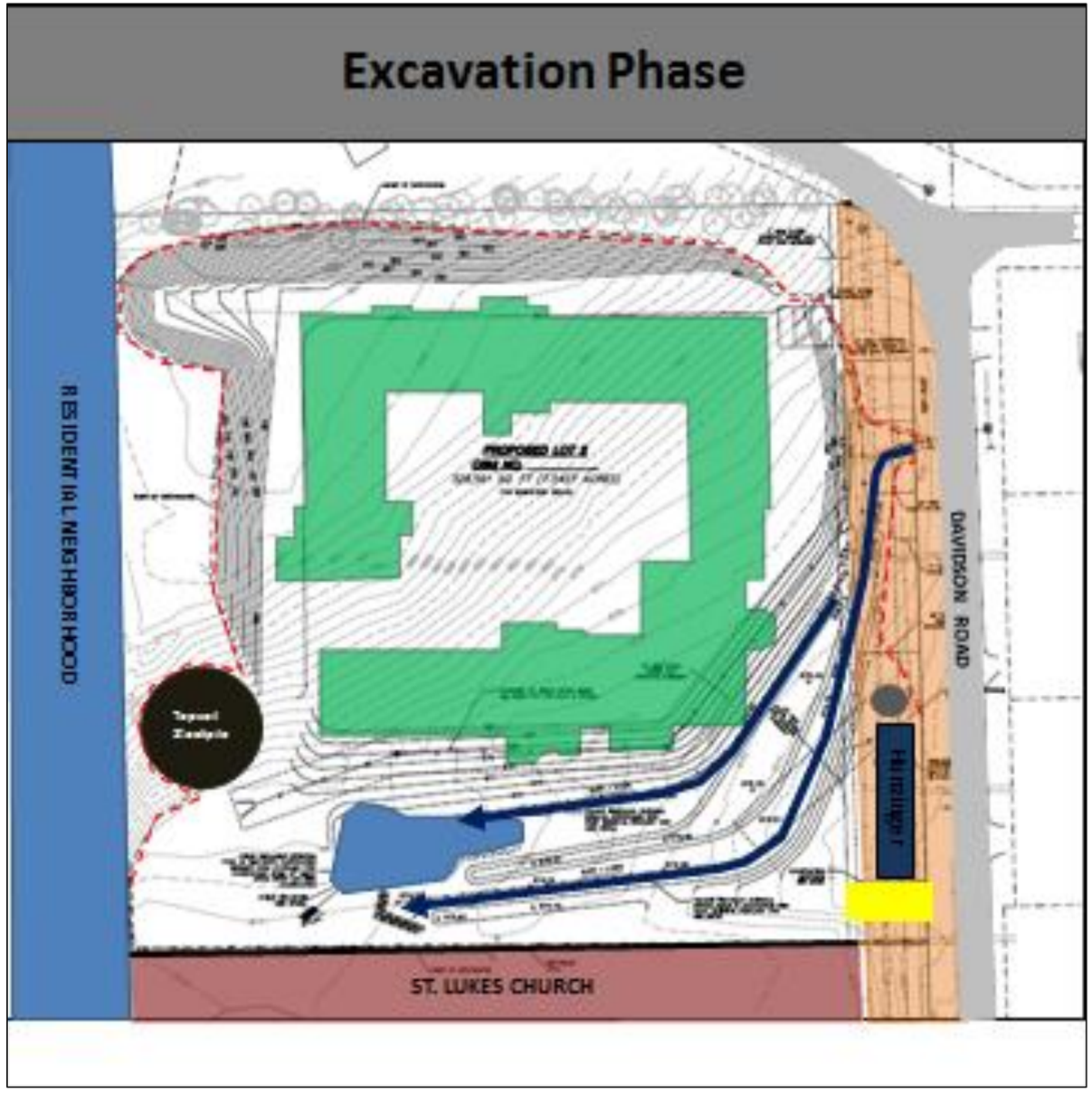
Item Code	Description	Qty	Unit	Material	Material Total	Installation	Installation Total	Total	Total/SF
D4010 410 0640	Wet Pipe sprinkler systems, steel, black, sch. 40 pipe, light hazard, one floor, 50,000 SF	45230	SF	$1.15	$52,014.50	$1.77	$80,057.10	$132,071.60	$2.92
D4010 310 0760	Dry Pipe sprinkler systems, steel, black, sch. 40 pipe	45230	SF	1.22	$55,180.60	1.62	$73,272.60	$128,453.20	$2.84
	Sub-total (location factor (104.4) applied)				$111,911.68		$160,076.21	$271,987.89	$6.01
	Misc. Material (5%)				$5,595.58			$5,595.58	
	O&P (10%)				$11,191.17		$16,007.62	$27,198.79	
	Total				$128,698.44		$176,083.83	**$304,782.265**	**$6.74**

Line Number	Description	Qty	Unit	Crew	Material Cost per Unit	Total Material	Labor Cost per Unit	Total Labor	Equipment Cost per Unit	Equipment Total	Total
33053403825	**Concrete Footings (3000 psi)**										
33053403825	Quad A	61	CY	C-14	$197.00	$12,017.00	$112.00	$6,832.00	$0.76	$46.36	$18,895.36
33053403825	Quad B	76.25	CY	C-14	$197.00	$15,021.25	$112.00	$8,540.00	$0.76	$57.95	$23,619.20
33053403825	Quad C	61	CY	C-14	$197.00	$12,017.00	$112.00	$6,832.00	$0.76	$46.36	$18,895.36
33053403825	Quad D	61	CY	C-14	$197.00	$12,017.00	$112.00	$6,832.00	$0.76	$46.36	$18,895.36
	Total										$80,305.28
	Slab on Grade (4000)										
33105350300	Quad A	188	CY	C-18	$106.50	$20,022.00					$20,022.00
33105350300	Quad B	235	CY	C-18	$106.50	$25,027.50					$25,027.50
33105350300	Quad C	188	CY	C-18	$106.50	$20,022.00					$20,022.00
33105350300	Quad D	188	CY	C-18	$106.50	$20,022.00					$20,022.00
	Total										$85,093.50
33105705800	**Slab on Grade Placement**	800	CY	C-18			$4.01	$3,208.00	$1.26	$1,008.00	$4,216.00
	Total										
33105350300	**Concrete Pier**										
		65.3	CY		$106.50	$6,954.45					$6,954.45
	Footings Reinforcement (Rebar)										
32110600552	Quad A	4323.7	lbs	4 Rodm	$0.50	$2,161.85	$0.38	$1,643.01			$3,804.86
32110600552	Quad B	5404.625	lbs	4 Rodm	$0.50	$2,702.31	$0.38	$2,053.76			$4,756.07
32110600552	Quad C	4323.7	lbs	4 Rodm	$0.50	$2,161.85	$0.38	$1,643.01			$3,804.86
32110600552	Quad D	4323.7	lbs	4 Rodm	$0.50	$2,161.85	$0.38	$1,643.01			$3,804.86
	Total										$16,170.64
	Concrete Pier Reinforcement										
32110600202	#3 to #7	4032	lbs	4 Rodm	$0.50	$2,016.00	$0.50	$2,016.00			$4,032.00
	Total										$4,032.00
	SOG Reinforcement										
32205500100	6 x 6 - W1.4 xW1.4	450	CSF	4 Rodm	$14.60	$6,570.00	$23.00	$10,350.00			$16,920.00
	Total										$16,920.00
	Concrete Block Foundation Wall										
42210260250	Reinforced #4 vert @ 48", 8" thick	8800	SF	D-8	$2.89	$25,432.00	$3.88	$34,144.00			$59,576.00
	Total										$59,576.00
	Structural Insulated Panels (Bearing Walls)										
61210100210	7/16" OSB - 1/2" GWB faces, EPS insul, 5-5/8" T - (G7)										
61210100210	Quad A	2860	SF	F-3	$3.69	$10,553.40	$1.23	$3,517.80	$0.37	$1,058.20	$15,129.40
61210100210	Quad B	1430	SF	F-3	$3.69	$5,276.70	$1.23	$1,758.90	$0.37	$529.10	$7,564.70
61210100210	Quad C	2860	SF	F-3	$3.69	$10,553.40	$1.23	$3,517.80	$0.37	$1,058.20	$15,129.40
61210100210	Quad D	2860	SF	F-3	$3.69	$10,553.40	$1.23	$3,517.80	$0.37	$1,058.20	$15,129.40
61210100160	7/16" OSB - 1/2" GWB faces, EPS insul, 73/8"" T - (G4b)	7070	SF	F-3	$4.15	$29,340.50	$1.44	$10,180.80	$0.42	$2,969.40	$42,490.70
	Total										$95,443.60
	Headers										
61110402057	2" x 8" pnuematic nailed	1120	LF	2 carp	$0.79	$884.80	$1.76	$1,971.20			$2,856.00
	Total										
	Shop Fabricated Roof Trusses										
61753100400	Metal Plate Connected - 44' to 60' span	42750	SF Flr	F-3	$0.61	$26,077.50	$0.22	$9,405.00	$3.19	$136,372.50	$171,855.00
61753100210	Metal Plate Connected - 24' 29' span	2250	SF Flr	F-3	$0.61	$1,372.50	$0.22	$495.00	$2.33	$5,242.50	$7,110.00
61753100800	Flat Wood Trusses 16' to 29' span	4523	SF Flr	F-3	$0.61	$2,759.03	$0.22	$995.06	$2.42	$10,945.66	$14,699.75
	Total										$193,664.75
	Beam and Post Schedule										
	2x10 pnuematic nailed	744	LF	2 Carp	$1.08	$803.52	$1.20	$892.80			$1,696.32
	Sheathing										
61636100102	Plywood on roof - 1/2" thick	54502	SF	2 Carp	$0.58	$31,611.16	$0.51	$27,796.02	$1.09	$59,407.18	$118,814.36
61636100102	Plywood for attic	45230	SF	2 Carp	$0.58	$26,233.40	$0.51	$23,067.30	$1.09	$49,300.70	$98,601.40
61636100102	Plywoof for Walls	34160	SF	2 Carp	$0.58	$19,812.80	$0.51	$17,421.60	$1.09	$37,234.40	$74,468.80
	Sub-total (with location factor 104.4)					$378,093.13		$198,645.91		$319,861.84	
	Misc. Materials (5%)					$18,904.66					
	Overhead and Profit (10%)					$37,809.31		$19,864.59		$31,986.18	
	Total					$434,807.10		$218,510.50		$351,848.02	**$1,005,165.62**

APPENDIX C

SITE LAYOUT PLANNING

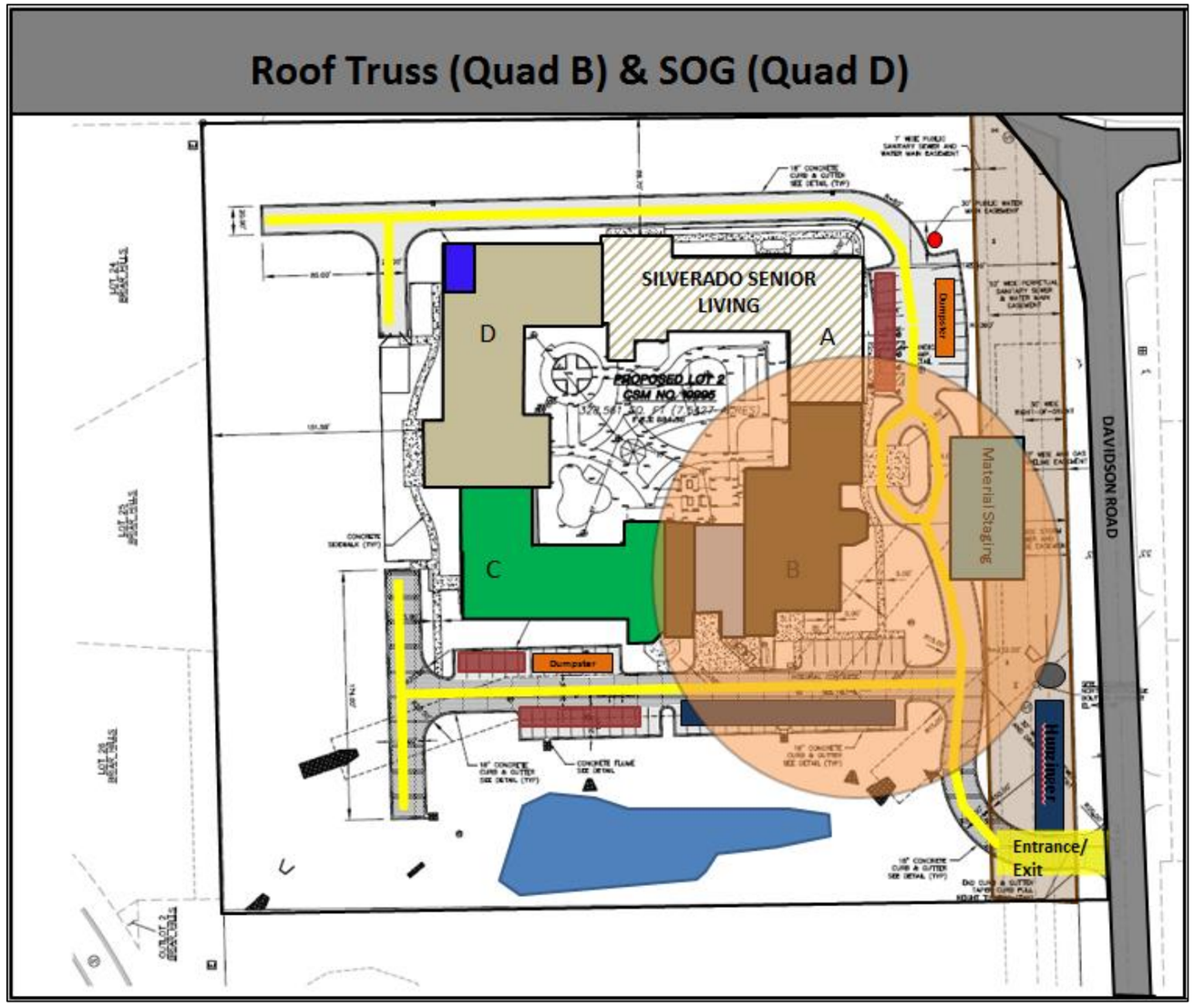
Excavation Phase



Legend

- Silt Fence
- Temporary Construction Sediment Basin
- Limits of Disturbance
- Construction Entrance/Exit
- Temporary Diversion Swale
- Public Water Main and Sanitary Sewer Easement
- Temporary Power Transformer

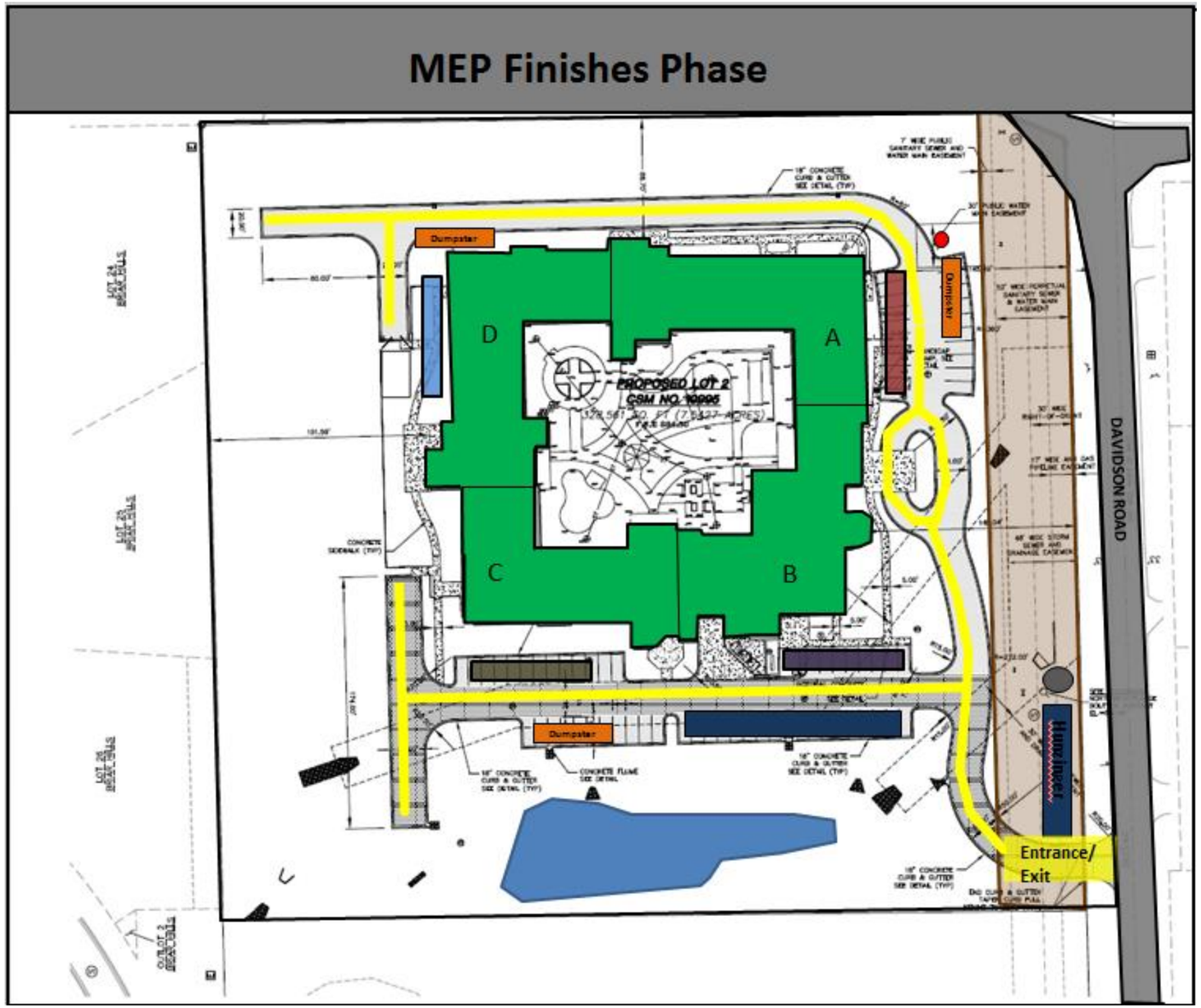
Roof Truss (Quad B) & SOG (Quad D)



LEGEND

- Dumpster
- Fire Hydrant
- Site Trailers & Temporary Bathrooms
- Access Route
- Parking
- Sanitary Sewer and Water Main Easement
- Crane Lift Radius
- Temporary Construction Sediment Basin
- Opening to Courtyard
- Enclosure for Pouring Concrete
- Not Completed

MEP Finishes Phase



LEGEND

- Dumpster
- Fire Hydrant
- Site Trailer & Temporary Bathrooms
- Access Route
- Material Staging (Electrical & HVAC Finishes)
- Material Staging (Casework & Carpet)
- Material Staging (Plumbing Finishes)
- Material Staging (Finish Paint)
- Sanitary Sewer and Water Main Easement
- Detention Pond

APPENDIX D

GENERAL CONDITIONS ESTIMATE

Insurance, Permits, & Bonding			
Item	**Cost per Unit**	**Construction Cost**	**Cost**
Insurance - All Risk	0.45% job	$7,612,506	$34,256.28
Performance Bond	1.50% job	$7,612,506	$114,187.590
Permits	0.75% job	$7,612,506	$57,093.80
Total			**$205,537.66**

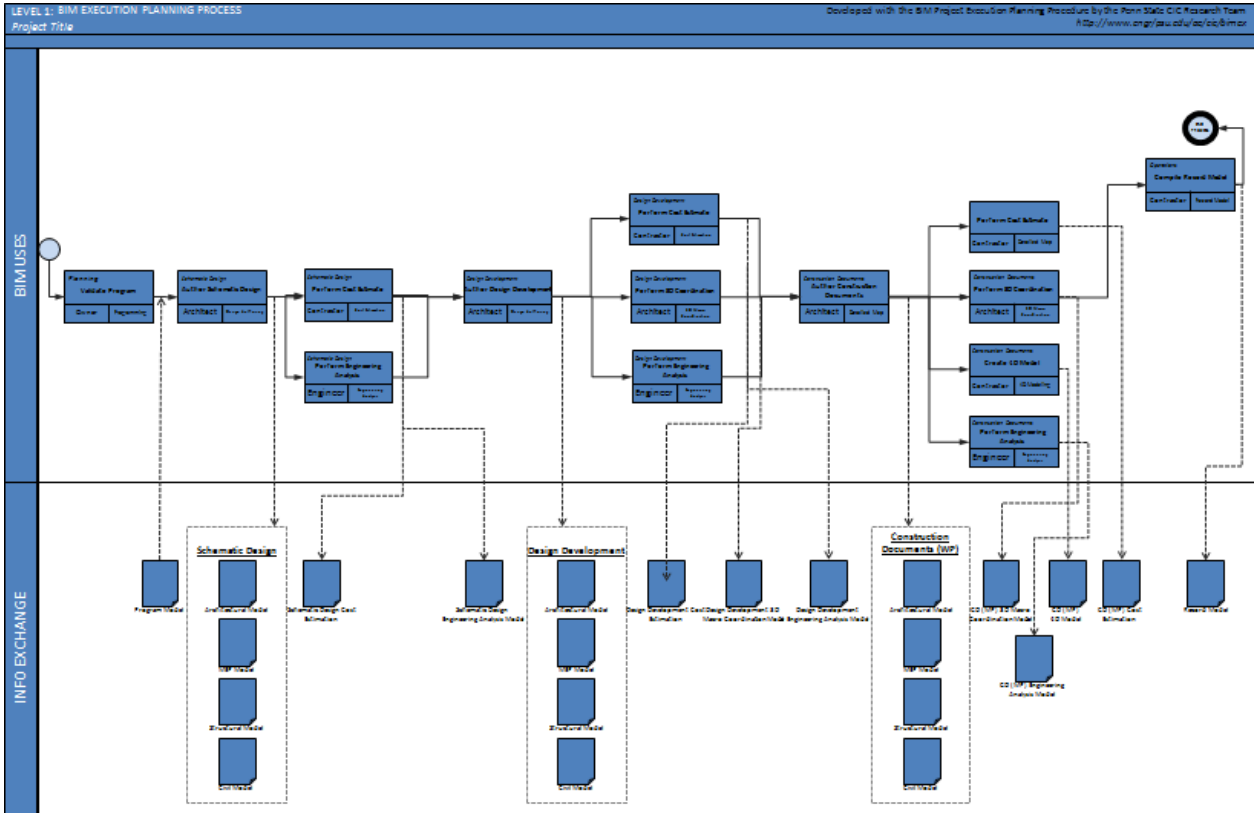
Management & Staffing					
Role	Quantity	Unit	Base Cost per Hour	Total	Notes
Project Executive	400.0	hr	$129.00	$51,600.00	8 hrs/wk x 50 wks
Sr. Project Manager	2000.0	hr	$88.00	$176,000.00	40 hrs/wk x 50 wks
Senior Estimator	360.0	hr	$93.00	$33,480.00	40 hrs/wk x 50 wks
General Superintendant	200.0	hr	$88.00	$17,600.00	4 hrs/wk x 50 wks
Superintendant	2000.0	hr	$77.00	$154,000.00	40 hrs/wk x 50 wks
Safety Officer	200.0	hr	$72.00	$14,400.00	4 hrs/wk x 50 wks
Total	**5160.0**			**$447,080.00**	

Temporary Utilities				
Description	**Quantity**	**Unit**	**Cost per Unit**	**Total Cost**
Telephone Charges	12	Month	$300.00	$3,600.00
Broadband/Internet Charges	12	Month	$400.00	$4,800.00
Cell Phone Charges	12	Month	$225.00	$2,700.00
Electric Power	12	Month	$650.00	$7,800.00
Drinking Water/Water Cooler	12	Month	$75.00	$900.00
Temporary Toilets	12	Month	$375.00	$4,500.00
Trailer Heat/Propane	12	Month	$450.00	$5,400.00
Total				**$29,700.00**

Equipment and Facilities	
Description	**Total Cost**
Office Trailor	$5,496.00
Trailer Setup and Breakdown	$900.00
Trailer Utility Hook-ups	$4,400.00
Trailor Towing	$800.00
Field Office Supplies (Avg.)	$3,000.00
Field Office Printer/Copier	$7,800.00
Site Signage	$1,500.00
Postage/Federal Express	$1,200.00
First Aid & Safety Supplies	$3,600.00
Fire Extinguishers	$1,500.00
Fire Extinguisher Stands	$1,800.00
Trash Disposal/Dumpsters	$34,416.00
Blueprints Throughout Construction	$3,500.00
Weekly Cleaning	$19,392.00
Auto Mileage	$1,400.00
Superintendant Truck Fuel	$4,000.00
Misc Tools	$6,600.00
Cargo Box	$3,000.00
Warehouse Trucking	$10,060.00
Yard Work	$9,090.00
Total	**$123,454.00**

APPENDIX E

BUILDING INFORMATION MODELING USE EVALUATION


LEVEL 1: BIM EXECUTION PLANNING PROCESS
Project Title
Developed with the BIM Project Execution Planning Procedure by the Penn State CIC Research Team
http://www.engr.psu.edu/ae/cic/bimpx
BIM USES
INFO EXCHANGE
Schematic Design
Design Development
Construction Documents (WP)