Zion*Solutions*, LLC.
Technical Support Document

TSD 14-014

End State Surface Areas, Volumes, and Source Terms of Ancillary Buildings

Revision 3

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Summary of Changes in this Revision:

- Rev. 2 – Added interior walls to Section A and E of the Main Steam Tunnels. Updated Figures 16, 17 and Tables 19, 20, 21, 25 and 60 with interior walls and a column in the Main Steam Tunnel Valve Houses.
- Rev. 3 – Added Buttress Pits

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1. PURPOSE

The purpose of this technical support document (TSD) is to calculate the end state surface areas, volumes and source terms of structures other than the Reactor Buildings and Auxiliary Building. The ancillary buildings encompass those whose substructures below the 588 foot elevation will remain in the end state and have the basement fill model applied but will not have significant source term remaining or have not yet been characterized because they are in use. The Spent Fuel Pool and Transfer Canal may have significant source term remaining but have not been characterized. The Waste Water Treatment Facility (WWTF) is also in use but source terms are expected to be minimal. Turbine Building and Crib House/Forebay characterization data indicate these structures have minimal contamination as well.

2. DISCUSSION

As discussed in the Reactor Building and Auxiliary Building technical support documents, (1) (2), the Exelon and Zion*Solutions* Asset Sale Agreement (3) requires all systems, structures, and components (SSCs) or "improvements" to be removed to 3 feet below finish grade of site (e.g., 588' elevation). Scoping and characterization surveys have been performed in all the substructures that will remain in the end state except for those in the Spent Fuel Building whose end state spent fuel pool and transfer canal substructures are inaccessible. The Unit 1 and 2 Reactor Buildings, Auxiliary Building and Spent Fuel Building end state structures are anticipated to contain the bulk of the end state radioactive source term and bound the potential future dose to the maximally exposed member of the critical group. The Containments and Auxiliary Building end state concrete has been characterized and the structures have separate detailed TSDs to estimate end state surface areas, volumes and source terms. The ancillary buildings addressed in this TSD are shown in yellow in Figure 1and consist of the Turbine Building, Crib House, Waste Water Treatment Facility (WWTF) and Spent Fuel Building. All other site buildings such as the Service Building and Diesel Generator Buildings will not have substructures below the 588 foot elevation remaining in the end state.

Scoping and characterization surveys indicate that the Turbine Building and WWTF contain detectable source terms at this time. The Turbine Building end state source term will consist of limited, localized embedded source term in the embedded piping in the concrete floor and source term in the floor drains. The floor drain characterization data and source term estimates are discussed in TSD 14-016 on end state embedded and buried pipe and penetrations. The equipment and floor drains in the 560 foot elevation slab will remain in the end state. The source term in the concrete floor has been characterized by scanning with a floor monitor and limited collection of concrete cores.

The WWTF is an operating facility required for National Pollutant Discharge Elimination System (NPDES) permit compliance. Therefore characterization has been limited to direct radiation and removable contamination surveys. Scoping surveys and cores in the Crib House have not detected radionuclides above background.

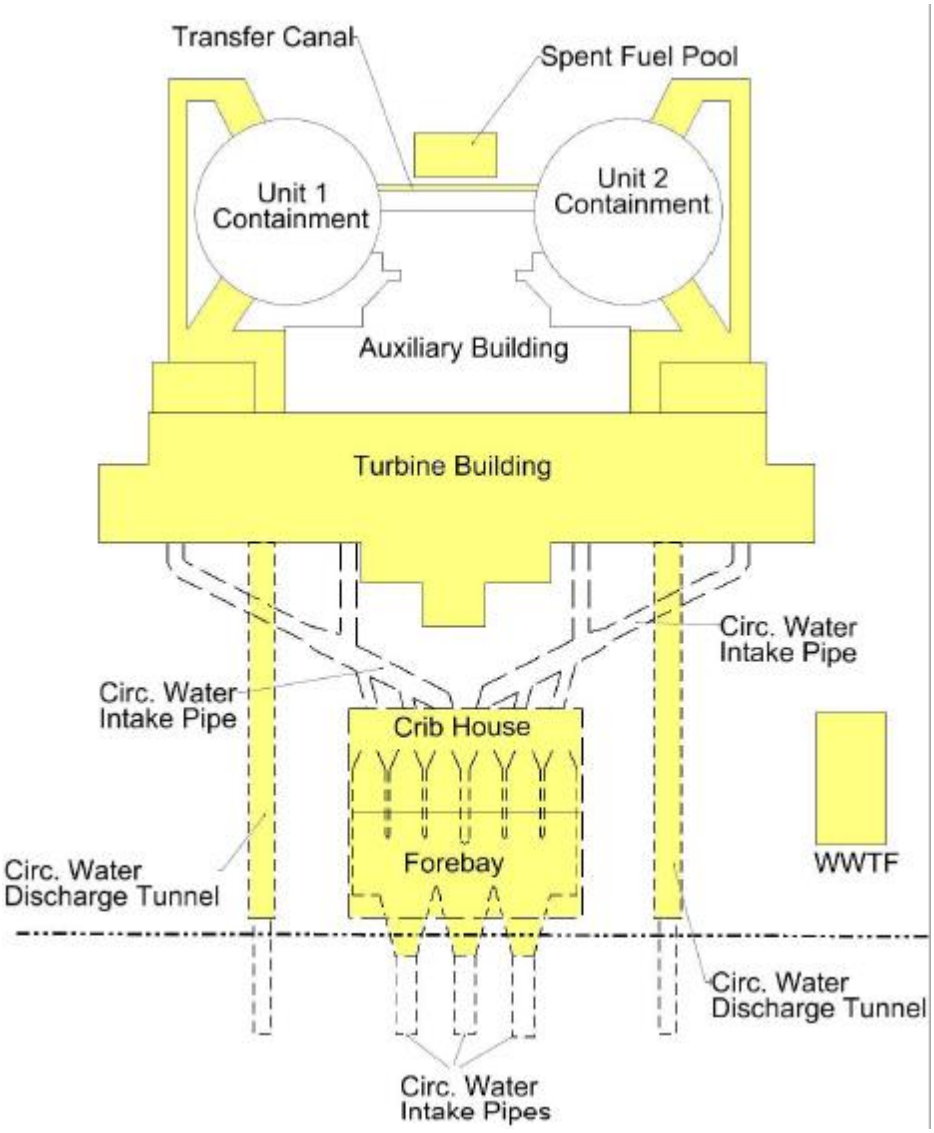


Figure 1- Ancillary Structures

3. CALCULATION

3.1. Turbine Building

3.1.1. End State Configuration

The turbine building end state will consist of the peripheral walls of the 560 foot elevation and associated Diesel Generator Building Oil Storage rooms, steam tunnels and discharge tunnels as shown in Figure 2 and Figure 3. It is possible that the walls between the Diesel Generator Oil storage rooms and the Turbine Building may be removed to create better access for commodity removal.

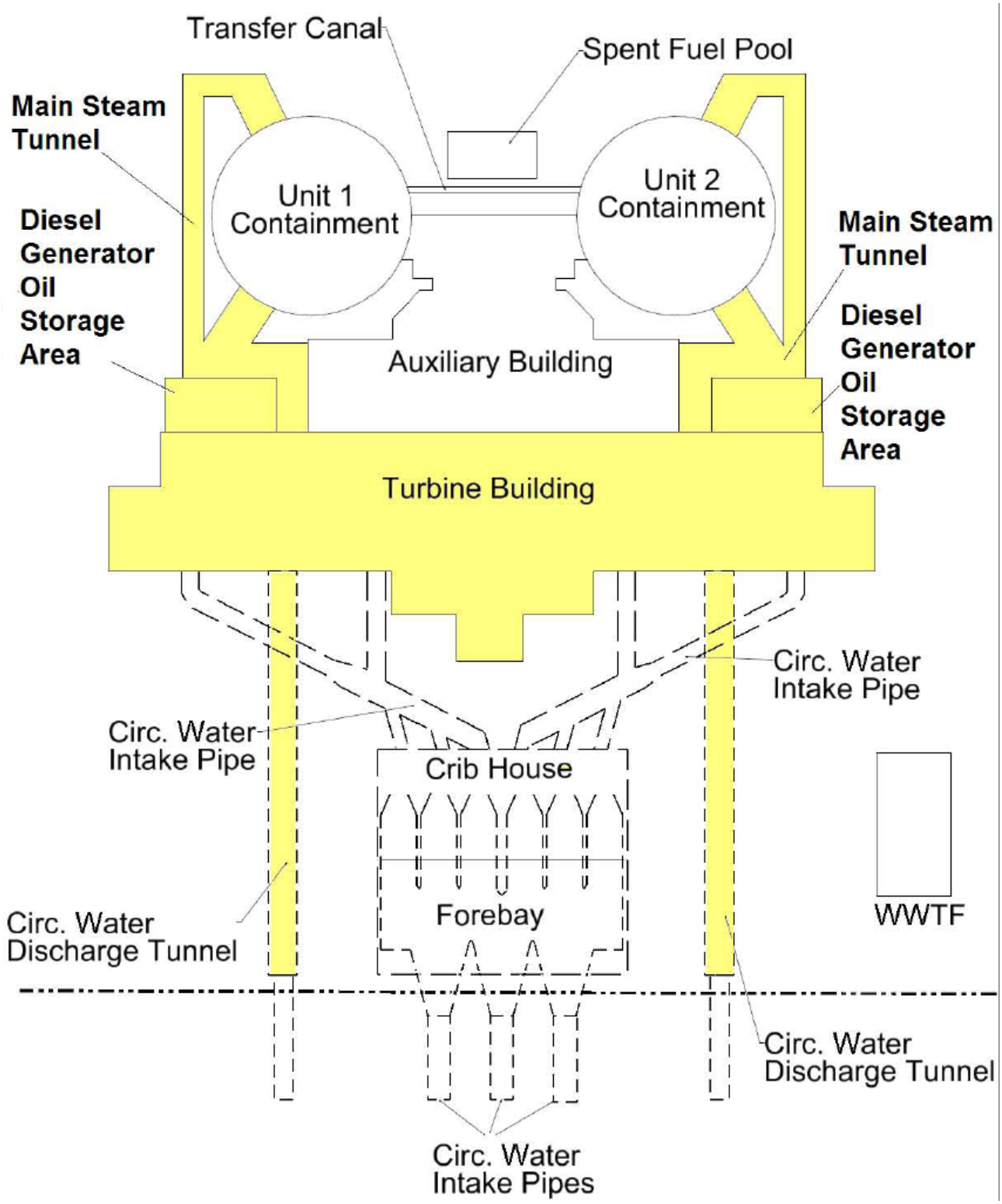


Figure 2 - Structures Evaluated as Part of Turbine Building Complex

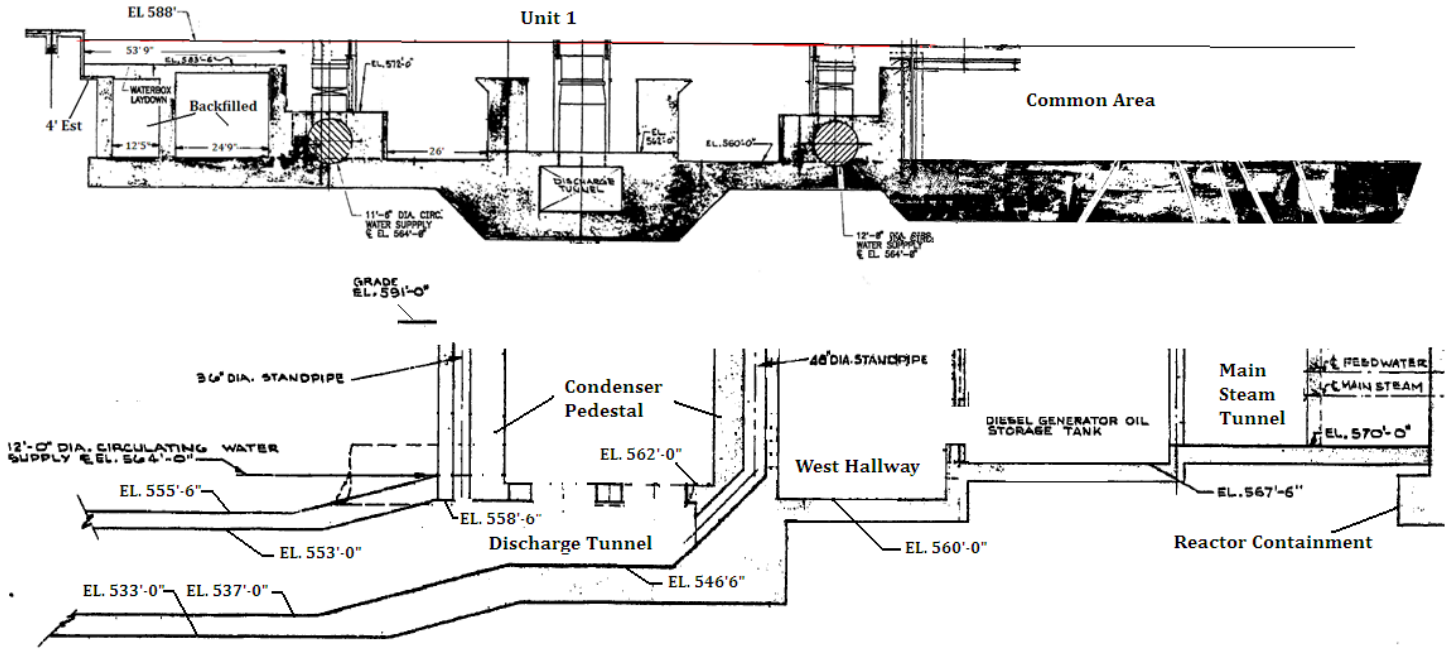


Figure 3 - Unit 1 Turbine Building Side

The Turbine Building has large concrete structures that support the Condensers, Turbine and Generators that are solid past the 588' elevation. The Circulating Water Intake and Discharge pipes are embedded in concrete above the 560 elevation. The steam tunnels are at the 570' elevation and the Diesel Generator Oil Storage rooms are at the 567' elevation. The Turbine Building sits on top of the Discharge Tunnels which also have multiple elevations as seen in Figure 4.

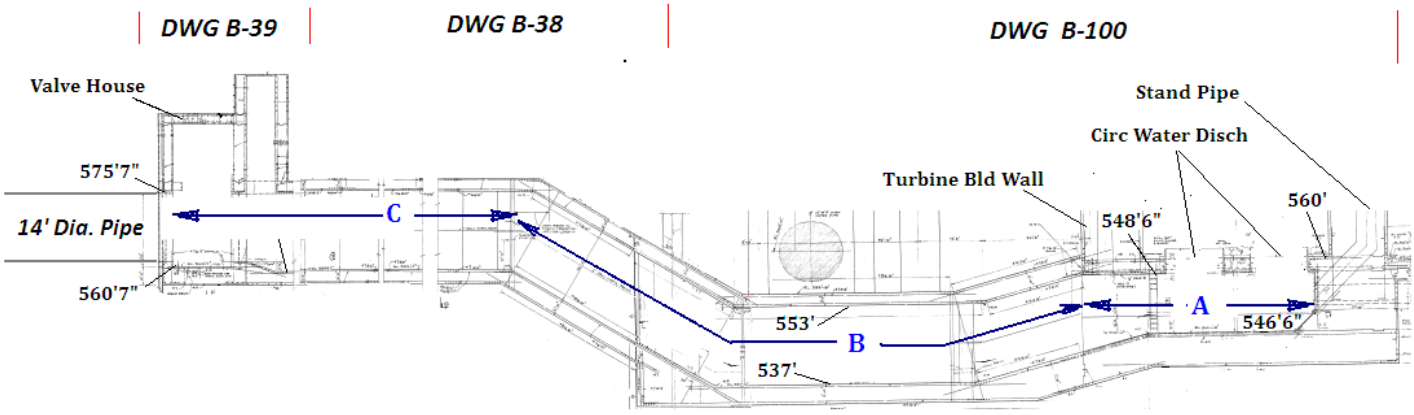


Figure 4 - Discharge Structure Side View

Thus, although all these areas are connected in the end state, the Turbine Building structure is complex.

3.1.2. Discharge Structure Surface Areas and Volumes

The Unit 1 and 2 Discharge Tunnels are identical. As seen in Figure 2and Figure 4 the Unit 1 and Unit 2 Discharge Tunnels run from under the Turbine Building Section A where two 12 foot diameter Circulating Water discharge pipes open to the tunnel from above, dip down under the Circulating Water Intake Pipe and then up again in Section B and then the section C portion to the

Valve House where it connects to the 14 foot diameter discharge pipe to the lake. The 14 foot diameter discharge pipe will be grouted closed at the valve house and is not considered part of the calculation. The details and dimensions of the discharge structure are provided in Drawings (DWG) B-100, B-38 and B-39 as a composite sketch in Figure 5.

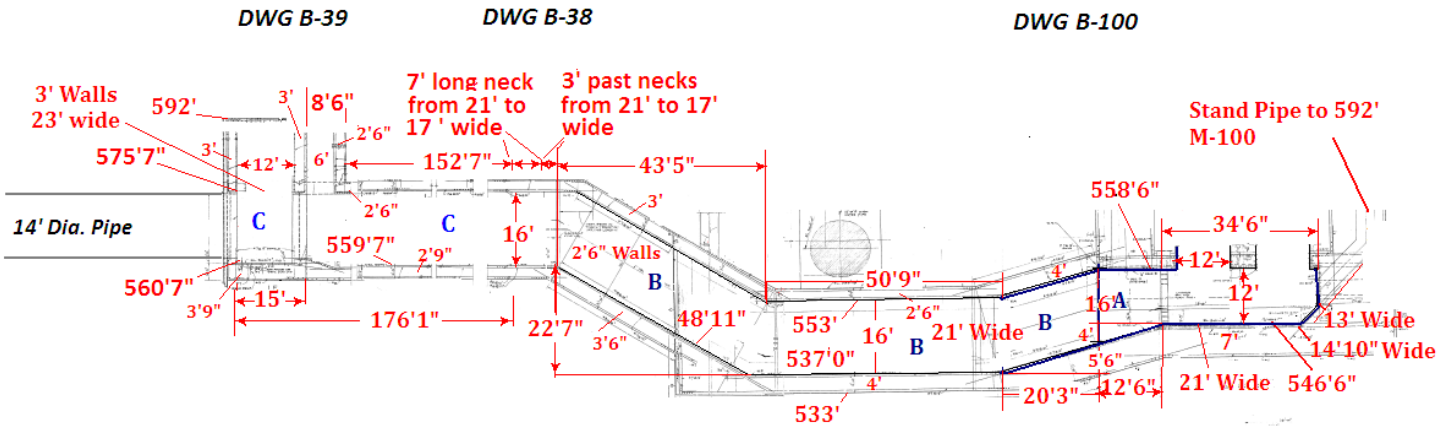


Figure 5 - Composite of Discharge Tunnel Dimensions

Section A is located under the Turbine Building as shown in Figure 6. A side view is provided in Figure 7.

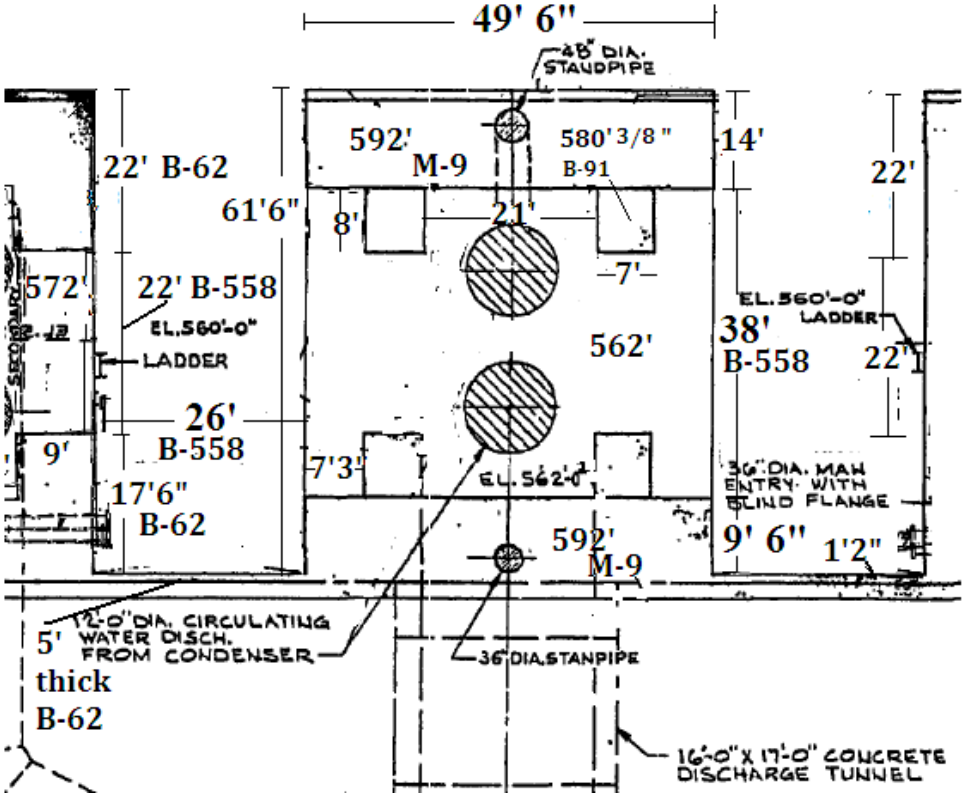


Figure 6 - Top View of Turbine Building Floor Over Section A of Discharge Tunnel

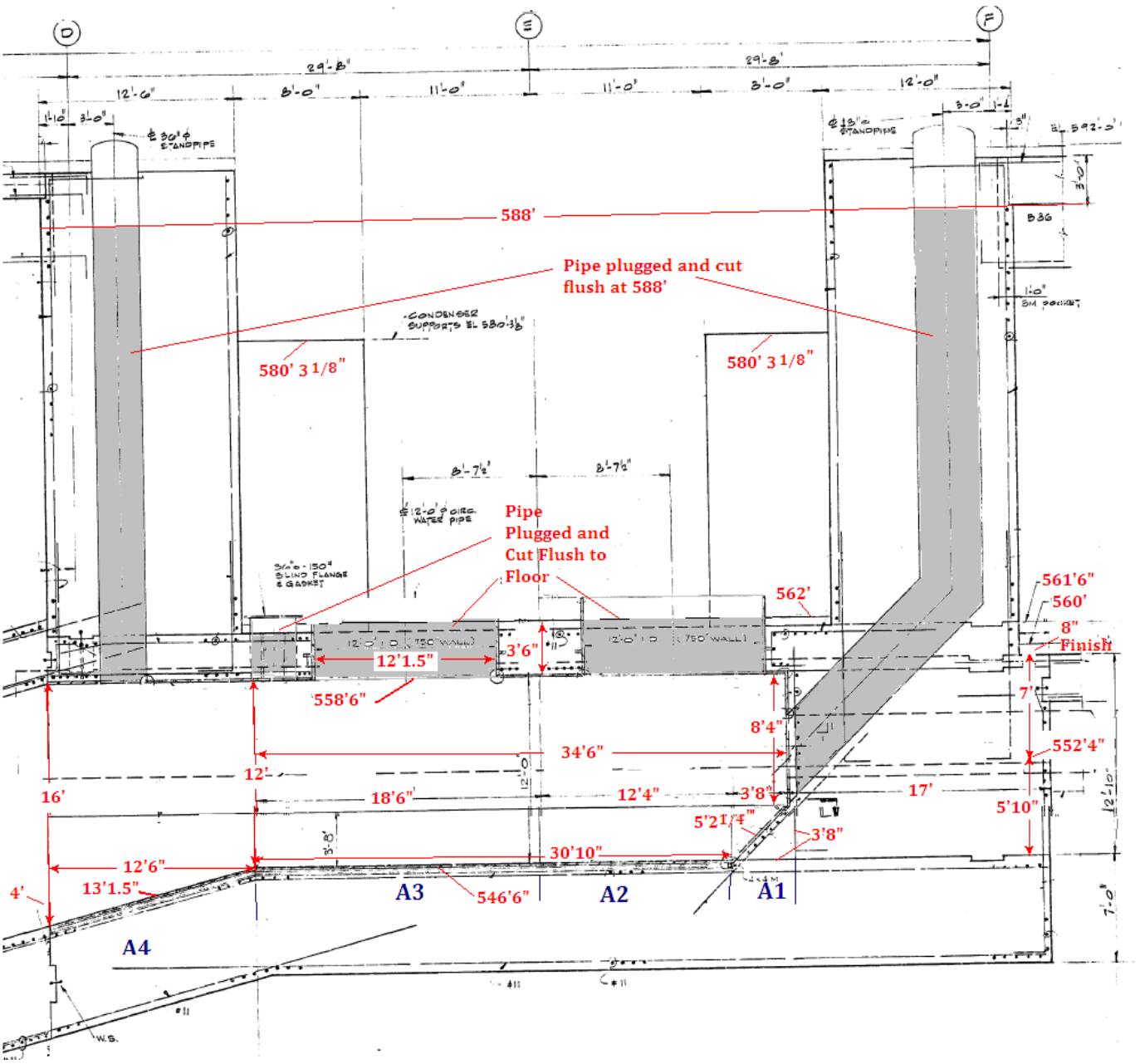


Figure 7 - Side View of Section A from B-100

A top view of the Section A tunnel floor is provided in Figure 8.

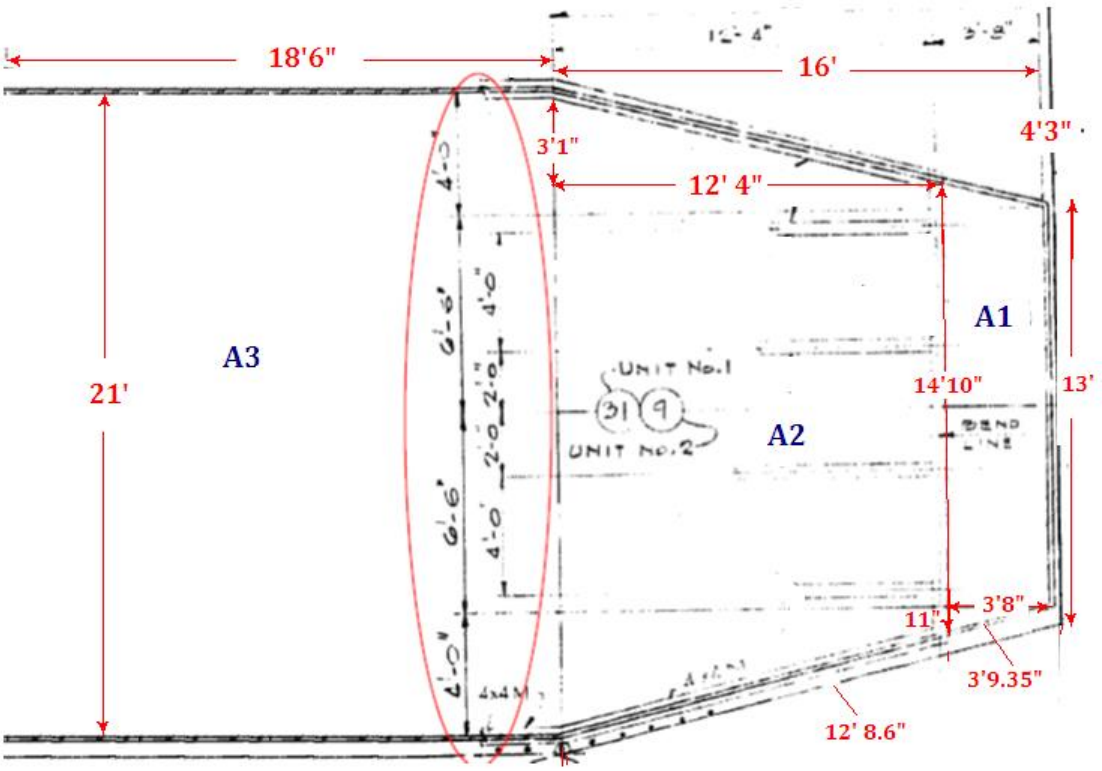


Figure 8 - Top View of Discharge Tunnel Section A Floor

The calculated surface areas of the floors, ceilings and walls are provided in Table 1.

Table 1 - Discharge Tunnel Wall Ceiling and Floor Surface Areas

Section	Item	Length ft	Width ft	Surface Area per Item ft^2	No Items	Total Surface Area ft^2
A1	Floor	5.19	13.92	72.16	1	72.16
A1	Ceiling	3.67	13.92	51.03	1	51.03
A1	N & S Wall	3.78	10.17	38.43	2	76.85
A1	West Wall	13.00	8.33	108.33	1	108.33
A2	Floor & Ceiling	12.33	17.92	220.97	2	441.94
A2	N & S Wall	12.71	12.00	152.55	2	305.11
A3	Floor & Ceiling	18.50	21.00	388.50	2	777.00
A3	N & S Wall	18.50	12.00	222.00	2	444.00
A4	Floor	13.12	21.00	275.61	1	275.61
A4	Ceiling	12.50	21.00	262.50	1	262.50
A4	N & S Wall	12.50	14.00	125.00	2	250.00
					Total	**3064.54**

The floor length of section A1the hypotenuse of a 3’8” by 3’8” triangle or the square root of 44” squared plus 44” squared or 5.19 feet. The mid-point width of A1 floor is 13’11” resulting in a surface area of 5.19 feet times 13.92 feet or 72.16 square feet. The A1 ceiling is 3’8” by 13’11” or

51.03 square feet. The north and south wall lengths are the square root of 3’8” squared plus 11” squared or 3.78 feet. Their height is the mid-point of the 3’8” triangle plus the 8’4” from the top of the slant or 10’2”. Each walls surface rea is 3.78 feet times 10.17 feet or 38.43 square feet each. There is also a back west wall in Section A1 that is intersected by the 48” stand pipe and the 48” Service Water Return pipe. Assuming these are plugged closed, the resulting surface rea is the 13’ width times the 8’4” height or 108.33 square feet. As seen in Figure 9 the Discharge Tunnel is surrounded by concrete which creates a void space in the 7’8” foot thick 560’ elevation floor and extends below it 12’10”.

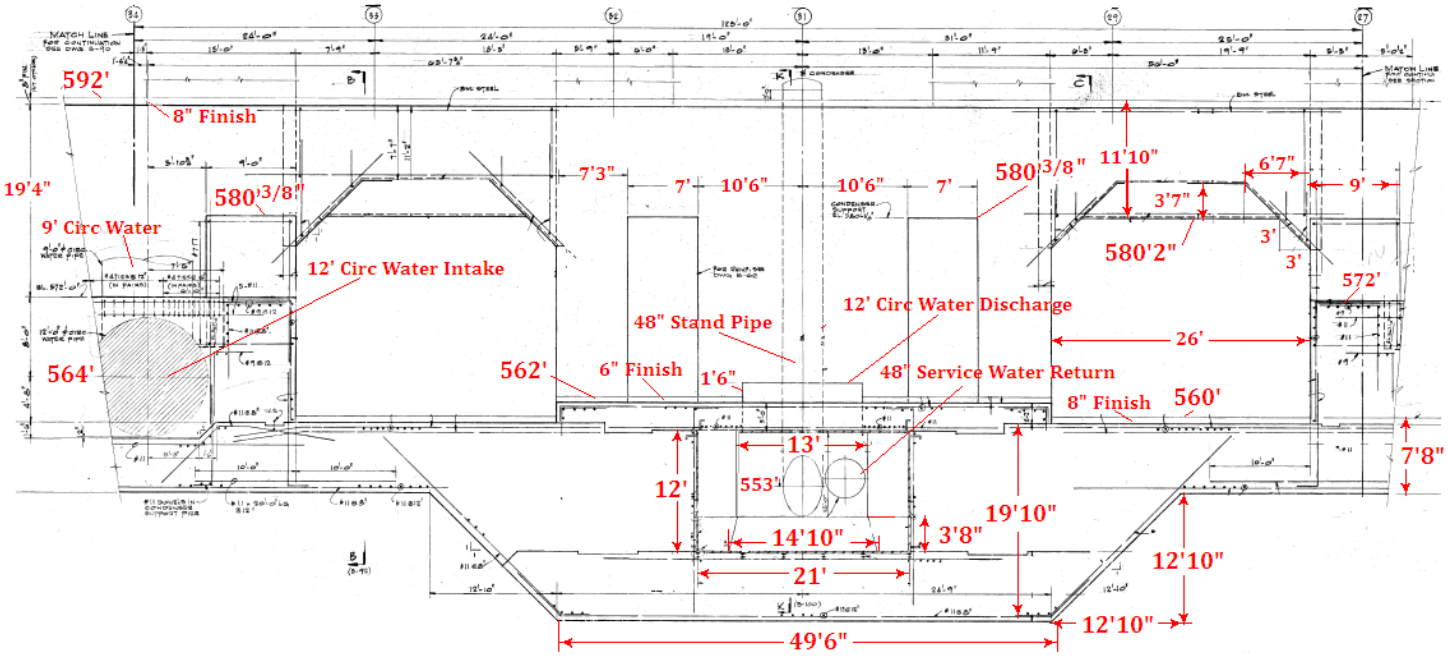


Figure 9 - Discharge Structure Section A1 - A3 Front View from B-91

As seen in Figure 7, the length of the Section A portion of the tunnel is 12’6”+34’6”+17’ or 64 feet long. As seen in Figure 9, 12’10” is below the 7’ thick 560 foot elevation floor slab. The volume uncorrected for void space is 49’6” + 12’10” or 62’4” times the 12’10” height and the 64’ length which equals 51,196.44 cubic feet (cf).

The void space of section A1 of the tunnel is that of the bottom 3’8” high slant at the start of the tunnel and the 8’4” by 3’8” thick wall portion above it. As seen in Figure 8 the width changes from 13’ at the start to 14’10” at the junction with section A2. The slant volume is 3’8” by 13’11” by 1’10” (i.e. ½ of 3’8”) or 93.55 cf. All of this volume is below the 7’8” thick floor slab. The portion above the slant is 8’4” by 3’8” by 13’11” or 425.23 cf of which 297.667 cf is below the 7’8” thick floor slab. Section A2 void space is 12 feet high by 12’4” long with a width that tapers from 14’10” to 21’. The void space volume is 12’4” by 17’11” by 12’ or 2,651.67 cf of which 1,289 is below the 7’8” thick slab. Section A3 is 18’6” long by 21 feet wide and 12 feet high or 4,662 cf of which 2,266.25 cf is below the 7’8” floor slab. Section A4 tapers downward 546’6” to 542’6” for a hypotenuse length of 13’1.5”. The volume of A4 is 12’6” long by 21’ wide by an average of 14’ high or 3,675 cf of which 2,056.25 cf is below the 7’8” floor slab. The Section A void space volumes are summarized in Table 2.

Table 2 - Section A of Discharge Tunnel Void Space Volumes

Section	Item	Length ft	Width ft	Height ft	Total Volume per Item ft^3	Total Vol in 7'8" Floor ft^3	Total Vol Below7' Floor ft^3
A1	Slant	13.92	3.67	1.83	93.55	0.00	93.55
A1	Above Slant	13.92	3.67	8.33	425.23	127.57	297.66
A2		17.92	12.33	12.00	2651.67	1362.66	1289.00
A3		21.00	18.50	12.00	4662.00	2395.75	2266.25
A4		21.00	12.50	14.00	3675.00	1618.75	2056.25
				Totals	**11507**	**5505**	**6003**

The concrete volume corrected for void space is 45,193.73 cubic feet.

As seen in Figure 5 Section B of the tunnel is outside the footprint of the Turbine Building and has three changes in elevation. The tunnel floor elevation drops by 5’6” from 542’6” to 537’.

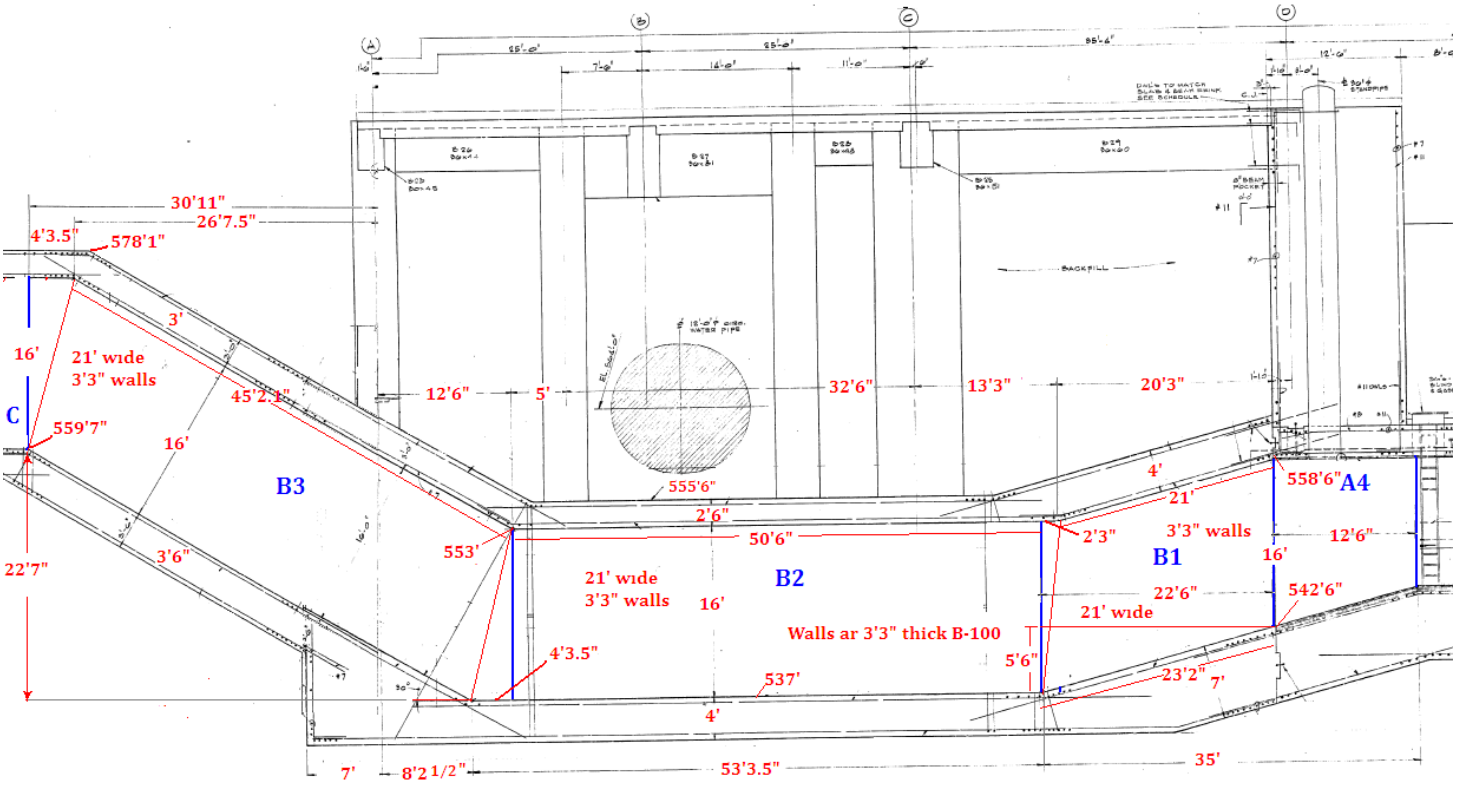


Figure 10 - Section B Side View from B-100 and B-38

The sloped ceiling of section B1 is the hypotenuse of 20’3 in by 5’6” triangle. It is the square root of 20’3”squared plus 5’6” squared or approximately 21 feet. Then there is a 2’3” horizontal section for a total ceiling length of 23.23 feet. At 21 feet wide this equals a ceiling surface area of 487.91 square feet. The sloped floor of B1 is the hypotenuse of a 22’6” by 5’6” triangle or 23.15 feet. At 21

feet wide the surface area is 486.41 square feet. The floor to ceiling height is 16 feet. The wall surface area is 22'6" by 16' or 360 square feet per wall.

The ceiling length of section B2 is 5 feet plus 32'6" plus 13'3" minus 2'3" or 50'6". At 21 feet wide the floor and ceiling surface area is 2,121 square feet. At 16 feet high the north and south wall surface areas are 1,616 square feet.

Section B3 rises 22'7" from 537' elevation to 559'7". The B3 floor and ceiling length is hypotenuse of a 39'1.5"by 22'7" triangle or approximately 45'2,"plus the 4'3.5" horizontal section or 49'5.5". At 21 feet wide this equals a total surface area of 2,077.60 square feet. The walls are 49'5.5" by 16 feet high or 791.47 square feet each. The interior surface areas of section B are provided in Table 3.

Table 3 - Discharge Tunnel Section B Surface Areas

Section	Item	Length ft	Width ft	Surface Area per Item ft^2	No Items	Total Surface Area ft^2
B1	Ceiling	23.23	21.00	487.91	1	487.91
B1	Floor	23.16	21.00	486.41	1	486.41
B1	N & S Wall	22.50	16.00	360.00	2	720.00
B2	Ceiling & Floor	50.50	21.00	1060.50	2	2121.00
B2	N & S Wall	50.50	16.00	808.00	2	1616.00
B3	Ceiling & Floor	49.47	21.00	1038.80	2	2077.60
B3	N & S Wall	49.47	16.00	791.47	2	1582.93
					Total	**9091.84**

Once again the entire interior volume of Section B is below the 579 foot elevation of the water table. The interior volume is the horizontal wall lengths of each section times the 21 foot width and 16 foot height. The interior volumes of each Section are provided in Table 4.

Table 4 - Discharge Tunnel Section B Interior Volumes

Section	Item	Length ft	Width ft	Height ft	Total Volume per Item ft^3
B1	Downward Sloping	22.50	21.00	16.00	7560.00
B2	Horizontal	50.50	21.00	16.00	16968.00
B3	Upward Sloping	49.47	21.00	16.00	16620.77
				Totals	**41149**

The wall and floor thicknesses vary over the length of Section B. In Section B the walls are 3'3" thick, adding 6'6" to the width or 27.5 feet wide. The Floor wall and ceiling concrete volumes are summarized in Table 5.

Table 5 - Discharge Tunnel Section B Floor Wall and Ceiling Concrete Volumes

Section	Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
B1	Ceiling	22.50	27.50	4	2475.00	1	2475.00
B1	Floor	22.50	27.50	7	4331.25	1	4331.25
B1	N & S Wall	22.50	16.00	3.25	1170.00	2	2340.00
B2	Ceiling	50.50	27.50	2.5	3471.88	1	3471.88
B2	Floor	50.50	27.50	4	5555.00	1	5555.00
B2	N & S Wall	50.50	16.00	3.25	2626.00	2	5252.00
B3	Ceiling	49.47	27.50	3	4080.99	1	4080.99
B3	Floor	49.47	27.50	3.5	4761.16	1	4761.16
B3	N & S Wall	49.47	16.00	3.25	2572.26	2	5144.52
				Total	**31043.54**	**Total**	**37411.80**

Section C of the Discharge Tunnel is the horizontal run to the Valve House where it connects the 14 foot diameter discharge pipe. The 14 foot discharge pipe will be plugged in the end state to close off contact with the lake. As seen in Figure 11, the width of the tunnel transitions from 21 feet wide to 17 feet wide and the wall thickness from 3'3" thick to 2'6" thick in Section C of the tunnel.

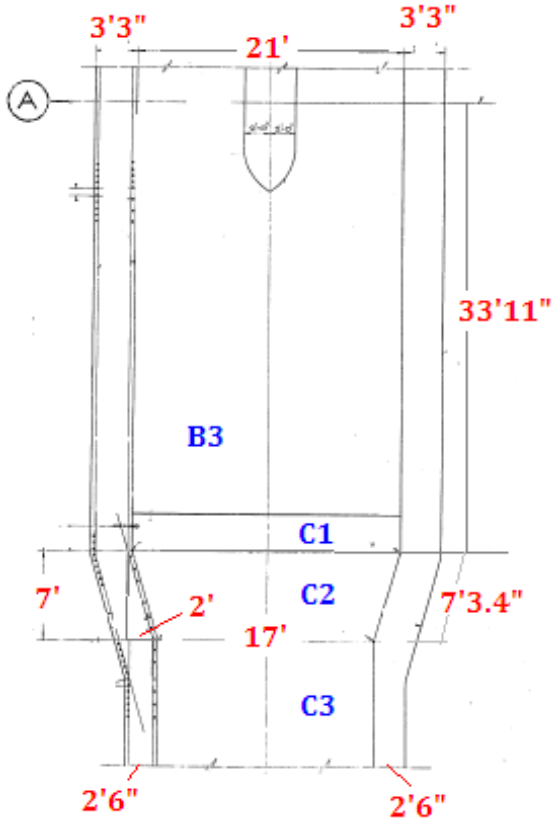


Figure 11 - Discharge Tunnel Section C Transition Top View

Figure 12 shows the side view of Section C including the valve house. Section C1 before the taper from 21 feet with to 17 feet wide starts is 3 feet long by 16 feet high and 21 feet wide. The floor and ceiling of the 7 foot long tapered section of C2 has an average with of 19 feet with wall lengths that are the square root of 7 feet squared plus 2 feet squared or 7'3.4". The length of the Section C3 ceiling and floor is the distance from the taper to the inner wall of the Valve House or 152'7" plus the 2'6" width of the wall or 155'1". The 155'1" length times the 17' wide floor and ceiling is 2,636.42 square feet each. The north and south walls surface areas are 155'1" times the 16 foot height or 2,481.33 square feet. Sections C4 and C5 will have no ceilings since remaining top elevation in the end state is the 588'. The only ceiling surface area will be the bottom of the wall in C4 at the 575' elevation which is 3 feet thick and 17 feet wide or 51 square feet. The floor of C4 has a 6 feet long section that rises 2 feet from 559'7" to 561'7". The hypotenuse floor length is 6.32 feet. The horizontal 3 foot section at the 561'7" results in a 9.32 foot long C4 floor that is 158.52 square feet.

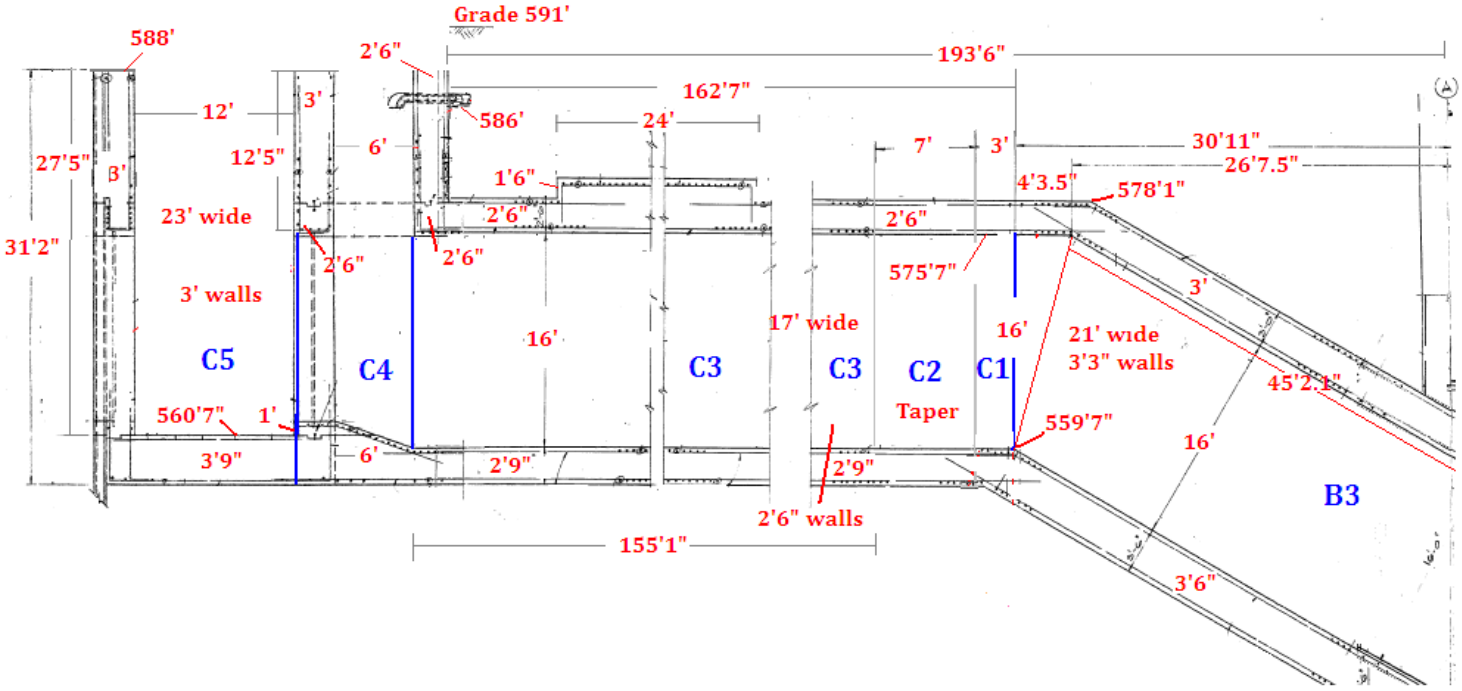


Figure 12 - Discharge Tunnel Section C Side View

The north and south walls of C4 include the 3 foot wide by 14' high portion under the wall which is 42 square feet and the mid-point height of 560'7" to the 588' elevation or 27'5" by the 6 foot length which is 159 square feet. C4 also includes the east west walls above 575'7"which are 12'5"high by 21' wide or 260.75 square feet each.

Section C5 is 12 feet long by 23 feet wide per drawing B-39. The C5 floor is 12 feet by 23 feet or 276 square feet. The north and south walls are 12 wide feet by 27'5" high or 329 square feet each. The east wall of C5 with the 14' diameter pipe plugged is 23' wide by 27'5' high or 630.58 square feet. The west wall is the same surface area with the 14' by 17' opening from C4 subtracted or 392.58 square feet. The Section C surface areas are summarized in Table 6.

Table 6 - Discharge Tunnel Section C Interior Surface Areas

Section	Item	Length ft	Width ft	Surface Area per Item ft^2	No Items	Total Surface Area ft^2
C1	Ceiling & Floor	3.00	21.00	63.00	2	126.00
C1	N & S Wall	3.00	16.00	48.00	2	96.00
C2	Ceiling & Floor	7.00	19.00	133.00	2	266.00
C2	N & S Wall	7.28	16.00	116.48	2	232.96
C3	Ceiling & Floor	155.08	17.00	2636.42	2	5272.83
C3	N & S Wall	155.08	16.00	2481.33	2	4962.67
C4	Ceiling	3.00	17.00	51.00	1	51.00
C4	Floor	9.32	17.00	158.52	1	158.52
C4	N & S Wall	3.00	14.00	42.00	2	84.00
C4	N & S Wall	6.00	27.42	164.50	2	329.00
C4	E & W Wall	12.42	21.00	260.75	2	521.50
C5	Floor	12.00	23.00	276.00	1	276.00
C5	N & S Wall	12.00	27.42	329.00	2	658.00
C5	E Wall	23.00	27.42	630.58	1	630.58
C5	W. Wall	23.00	27.42	392.58	1	392.58
					Total	**14057.65**

The void space below the water table (579’ level) of Section C1 through C3 is the floor surface areas times the 16 foot tunnel height.

Table 7 - Void Space Below Water Table Volumes of C1 through C3

Section	Item	Surface Area ft2	Height ft	Total Volume per Item ft^3
C1	Pre Taper	63.00	16.00	1008.00
C2	Taper	133.00	16.00	2128.00
C3	Post Taper	2636.42	16.00	42182.67
			Totals	**45319**

The void space volume of Section C4 is half of the 6’ by 17’ by 2’ high section below the 561’7” elevation and the volume from the 561’7 inch to 579’ elevation that is 17’5” high by 6 feet long by 17 feet wide. There is also a volume under the wall between C4 and C5 that is 3 feet long by 17 feet wide and 15’ high. The void space volume in Section C5 is 12 feet long by 23 feet wide and 18’5” high.

Table 8 - Void Space of Section C4 and C5

Section	Item	Length ft	Width ft	Height ft	Total Volume per Item ft^3
C4	Bottom Triangle	6	17	1	102
C4	Gap to 579'	6	17	17.42	1777
C4	Under Wall	3	17	14	714
C5	To 579'	12	23	18.42	5083
				Totals	**7676**

The Section C concrete volumes of the end state floors, walls and ceilings are summarized in Table 9.

Table 9 - Discharge Tunnel Section C Estimated Floor, Ceiling and Wall Concrete Volumes

Section	Item	Length ft	Width ft	Thickness ft	Surface Area per Item ft^3	No Items	Total Surface Area ft^2
C1	Ceiling	3.00	27.50	2.5	206.25	1	206.25
C1	Floor	3.00	27.50	2.75	226.88	1	226.88
C1	N & S Wall	3.00	16.00	3.25	156.00	2	312.00
C2	Ceiling	7.00	25.50	2.5	446.25	1	446.25
C2	Floor	7.00	25.50	2.75	490.88	1	490.88
C2	N & S Wall	7.28	16.00	3.25	378.57	2	757.13
C3	Ceiling	155.08	22.00	2.5	8529.58	1	8529.58
C3	Floor	155.08	22.00	2.75	9382.54	1	9382.54
C3	N & S Wall	155.08	16.00	2.5	6203.33	2	12406.67
C4	Floor	6.00	22.00	2.75	363.00	1	363.00
C4	Floor	6.00	22.00	1	132.00	1	132.00
C4	N & S Wall	6.00	27.42	2.5	411.25	2	822.50
C4	W Wall	17.00	9.92	2.5	421.46	1	421.46
C4	East Wall	29.00	31.17	3	1997.50	1	1997.50
C5	Floor	15.00	29.00	3.75	1631.25	1	1631.25
C5	N & S Wall	15.00	27.42	3	1233.75	2	2467.50
C5	E Wall	23.00	27.42	3	1891.75	1	1891.75
				Total	**26020.27**	**Total**	**33253.17**

The ceiling of Section C1 is 2’6” thick by 3 feet long. The ceiling width is the 21 foot width of the tunnel interior plus the 3’3” thick walls or 27’6” wide. The floor of C1 is 2’9” thick, by 3 feet long and 27.5 feet wide when the 3’3” wall thicknesses are included. The C1 north and south walls are 3 feet long by 3’3” thick by 16 feet high. The C2 tunnel ceiling is 2’6” thick by 7 feet long times an average width of 19 feet plus the 6’6” of the walls or 25.5 feet wide. The floor has the same dimensions but is 2’9” thick. The walls are 7.28 feet long by 16 feet high and 3.25 inches thick. The

ceiling of C3 is 2'6" thick by 155'1" long. The width is 17 feet plus the 5 feet from the 2'6" thick walls or 22 feet. The floor is the same dimensions but 2'9" thick. The north and south walls are 155'1" long by 16 feet high and 2'6" thick.

The floor of C4 is the 22 (17 + 2.5*2) foot wide 2'9" thick by 6 foot long section plus the 6 foot by 22 foot with a 1foot high mid-point of the sloped floor section on top of it. The horizontal portion of the floor under the east wall will be included in the concrete volume of the wall. The volume of the north and south walls is the mid-point height of 27'5" by the 6 foot length and the 2'6" wall thickness. That portion corresponding to the east wall will be calculated as part of the volume of the east wall. The west wall portion above the ceiling is 17 feet plus 5 feet for the 2'6" walls wide or 22 feet wide, 2'6 inches thick and its height is from the top of the ceiling at 578'1" to the 588' elevation or 9'11". The east wall of C4 is 3 feet thick, 29 feet wide (i.e., width of C5 with the 3 foot wall thicknesses are included) and 31'2" high with a 14' by 17' opening. The floor of C5 is 29 feet wide by 15 feet long and 3'9" thick. The north and south walls are 15 feet long 27'5" high by 3 feet thick. The east wall of C5 assumes the 14foot diameter pipe that penetrates it is plugged with concrete or grout and is therefore 23 feet wide by 27'5" high and 3 feet thick.

The Discharge Tunnel calculated surface areas, void space below the water table and end state concrete volumes are summarized in Table 10.

Table 10 - Discharge Tunnel Calculated Surface Areas, Void Space and Concrete Volumes

Section	Interior Surface Area ft^2	Total Void Below Space 579' ft^3	Total End State Concrete ft^3
A	3065	11507	45193.73
B	9092	41149	37411.80
C	14058	52994	33253.17
Total	**26,214**	**105,650**	**115,859**

3.1.3. Unit 1 and 2 Surface Areas and Volumes

The Turbine Building basement is at the 560' elevation for the Unit 1 and 2 Areas and has the Common Area between them. The Unit basement areas consist of an area where the Condenser Pedestals are on the East Side of the Building, a Hallway, the Main Steam Tunnel and the Diesel Generator Oil Storage Area on the West side as shown in Figure 13. The Unit 1 and 2 areas are mirror images of each other. Since the next floor is the 592 foot elevation and the Main Steam Tunnels will be access from above, it is assumed there are no ceilings in the Turbine Building end state structure. In order to expedite material load out and commodity removals using large excavators it is also assumed the all interior walls such as those between tanks in the Diesel Generator Oil Storage Area and between the Common Area and Units 1 and 2 are removed. The only walls assumed to remain are those between the Diesel Generator Oil Storage Area and the West Hallway of the Turbine Building.

The Diesel Generator Oil Storage Area and West Hallway are relatively simple geometries for calculation of surface areas, void spaces and concrete volumes. The Diesel Generator Oil Storage Area floor is at the 567'6" elevation making the walls 20'6" high to the 588'. The West Hallway of the Turbine Building is at the 560' elevation making the walls to the 588' elevation 28 feet high.

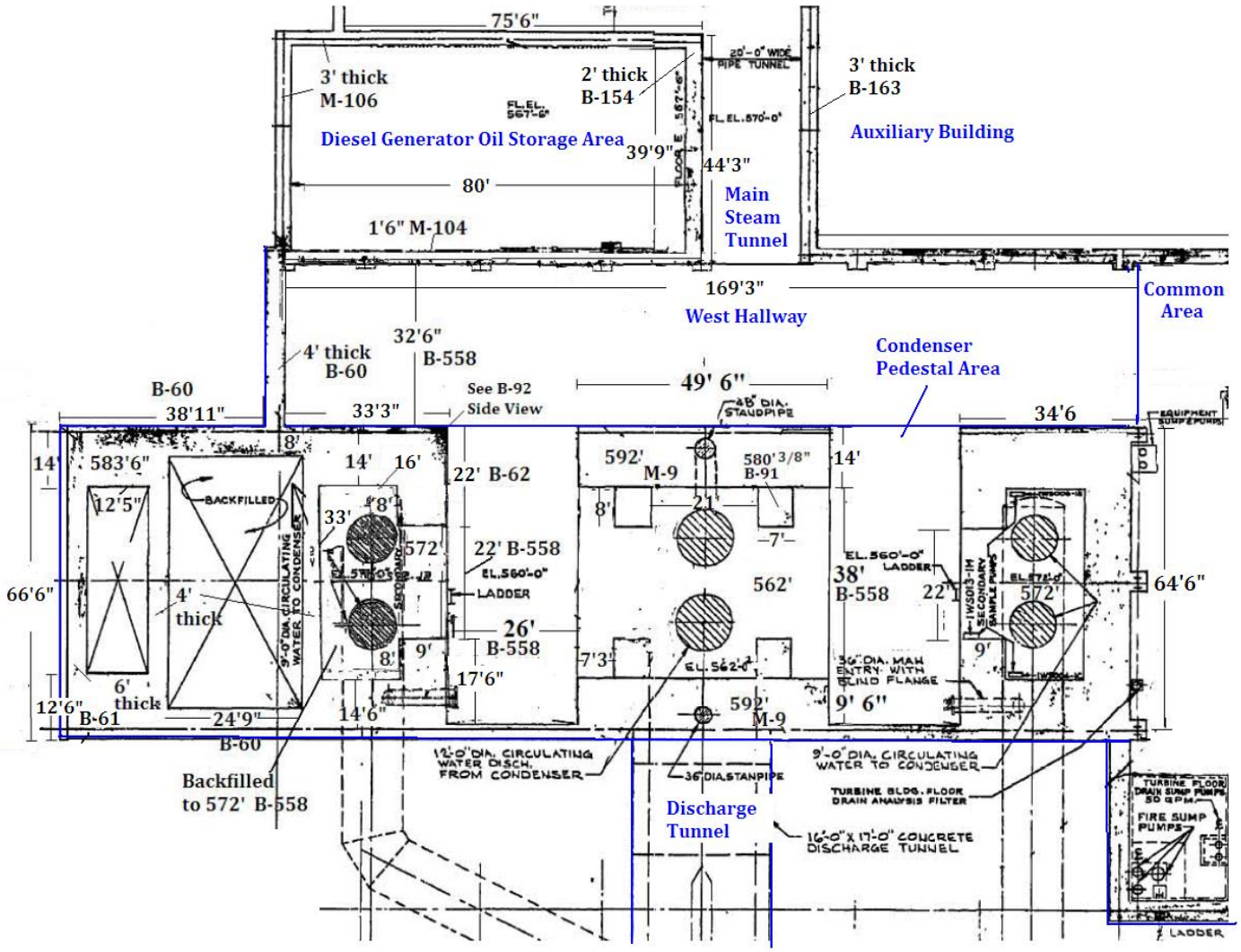


Figure 13 - Turbine Building End State Unit 1 Area Example

The estimated floor and wall surface areas for the Diesel Generator Oil Storage Area and West Hallway of a single Unit are provided in Table 11.

Table 11 - Estimated Surface Areas for Diesel Generator Oil Storage Area and Turbine Building West Hallway

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Diesel Oil Storage Room Floor	80	39.75	3180	1	3180
Diesel Oil Storage Room N&S Wall	41	20.5	840.5	2	1681
Diesel Oil Storage Room E&W Wall	83	20.5	1701.5	2	3403
West Hall Way Floor	169.25	32.5	5500.63	1.00	5500.63
West Hallway South Wall	32.5	28	910	1	910
West DG Wall	82	28	2296	1	2296
West Wall Below Main Steam Tunnel	20	10	200	1	200

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
West Wall Adj to Aux Bld	67.25	28	1883	1	1883
		Totals	**16511.63**		**19053.63**

The void space to the water table is the surface area of the floor times the distance to the 579' elevation as seen in Table 12

Table 12 - Estimated Water Table Void Spaces for Diesel Generator Oil Storage Area and West Hallway

Item	Length ft	Width ft	Height to Water Table ft	Total Volume per Item ft^3
Diesel Oil Storage	80.00	39.75	11.50	36570.00
West Hallway Floor	169.25	32.50	19.00	104511.88
			Totals	**141082**

The floor concrete volume calculations included the portion under the walls for the Diesel Generator Oil Storage Area. The wall volumes were from the floor elevation to the 588' end state elevation. Only the South wall of the West Hallway was considered for concrete volume since the West Wall was already included in the Auxiliary Building concrete volume estimates.

Table 13 - Estimated Floor and Wall Concrete Volumes for Diesel Generator Oil Storage Area and West Hallway

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Diesel Oil Storage Room Floor	85.00	44.25	7.67	28836.25	1	28836.25
DG Oil Store South Wall	39.75	20.50	3	2444.63	1	2444.63
DG Oil Store North Wall	39.75	20.50	2	1629.75	1	1629.75
DG Oil Store East Wall	83.50	28.00	1.5	3507.00	1	3507.00
DG Oil Store West Wall	85.00	20.50	3	5227.50	1	5227.50
West Hallway Floor	173.25	32.50	7.67	43168.13	1	43168.13
West Hallway South Wall	32.50	28.00	4	3640.00	1	3640.00
			Total	**88453.25**	**Total**	**88453.25**

The Condenser Pedestal Area contains massive concrete buttresses that will remain in the end state. These consist of the North and South Circulating Water Intakes to the Condenser and the Circulating Water Discharge from the Condenser to the Discharge Tunnel in between them as shown in Figure 13. The South Condenser pedestal area extends past West Hallways southern wall and includes two large backfilled void spaces as shown in Figure 14 and Figure 15

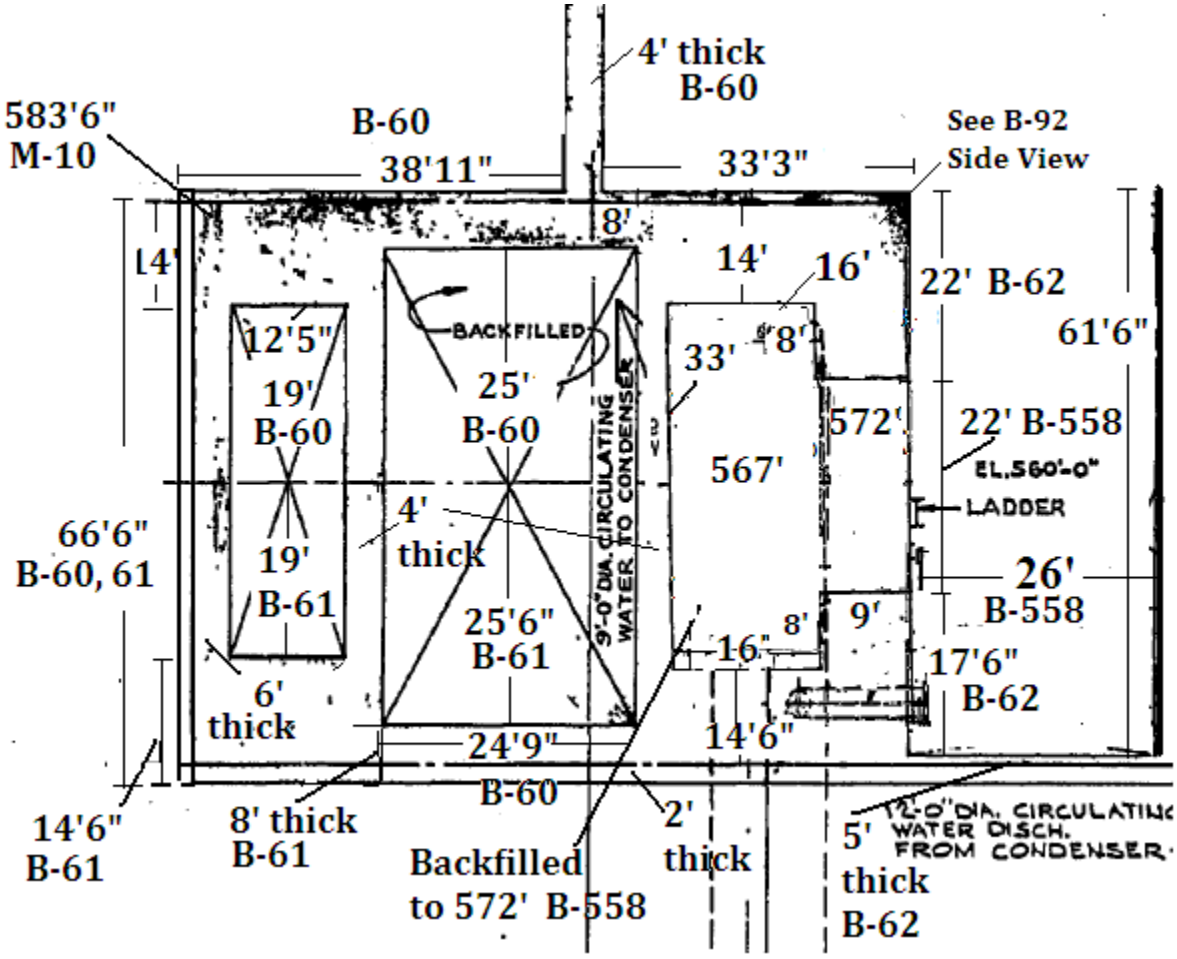


Figure 14 - Top View of South Condenser Pedestal Area

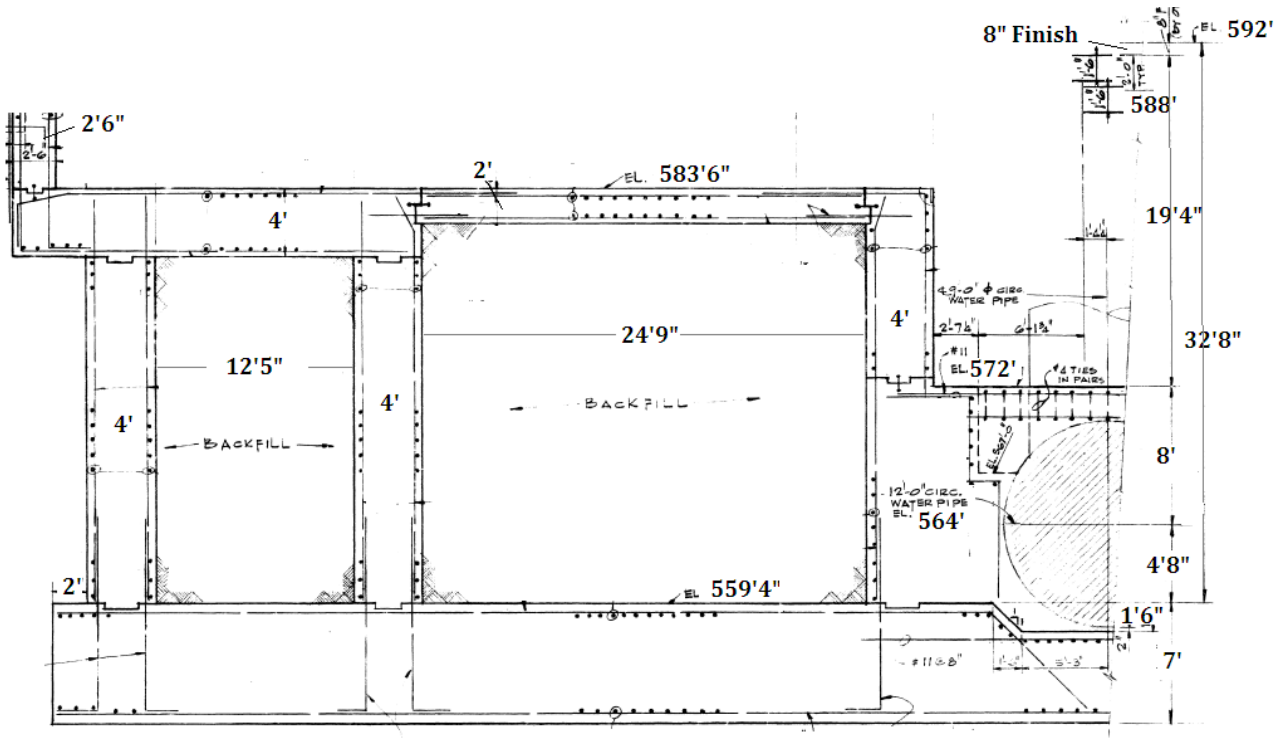


Figure 15 - Side View of South Condenser Pedestal Area from Drawing B-90

As seen in Figure 15 there is a 583'6" concrete floor above the backfilled void spaces that will form a solid slab up to and around the key way cut out at the 572' elevation and the pit around the intake pipe on the 567' elevation. This is 76'2 inches by 66'6" or 5,065 square feet minus the keyway surface area of 22' by 9' (128 sq ft) and 16' by 33' (429 sq ft) or 4,438.08 square feet at the 583'6". The wall surface areas will be those accessible from the 560' elevation and those associated with the keyway. The 560' floor area north of the pedestal is also include in the calculations.

The North Condenser Pedestal is very similar to the South Condenser Pedestal with the exception of not having the extended length from the backfilled areas as seen in Figure 13. All the dimensions are identical with the exception of the 34'6" West Wall length. The calculated surface areas for the South and North Condenser Pedestal Areas are provided in Table 14.

Table 14 - South Condenser Pedestal Surface Areas

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
South Condenser Pedestal 583'6" Floor	76.17	66.5	4339.0833	1	4339.083
S. Cond Ped KeyWay 572' Surface Area	9	22	198	1	198
S. Cond Ped Keyway 567' Surface Area	16	33	528	1	528
S. Cond Ped West Wall with Hallway	33.25	23.5	781.375	1	781.375
S. Cond Ped N. Wall Minus 572' Opening	61.5	23.5	1192.25	1	1192.25
S. Cond Ped E&W 572' Access Walls	9	11.5	103.5	2	207
S. Cond Ped Interior 567' Key Way Walls Without 572' Access Cut out	98	16.5	1364	1	1364

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
North 560' Floor Area	26	61.5	1599	1	1599
		Totals	**10105.208**		**10208.71**
North Condenser Pedestal 583'6" Floor	34.50	66.5	1568.25	1	1568.25
N. Cond Ped KeyWay 572' Surface Area	9	22	198	1	198
N. Cond Ped Keyway 567' Surface Area	16	33	528	1	528
N. Cond Ped West Wall with Hallway	34.5	23.5	810.75	1	810.75
N. Cond Ped S. Wall Minus 572' Opening	61.5	23.5	1192.25	1	1192.25
N. Cond Ped E&W 572' Access Walls	9	11.5	103.5	2	207
N. Cond Ped Interior 567' Key Way Walls Without 572' Access Cut out	98	16.5	1364	1	1364
South 560' Floor Area	26	61.5	1599	1	1599
		Totals	**7363.75**		**7467.25**

Most of the south Condenser pedestal is above the water table at 583’6”. Only the keyway openings are below the 579’ elevation. The geometry is complicated and it is not known if the partially embedded pipe will be grouted and left below 567’ elevation or not. For conservatism only, the volume above 572’ elevation in the keyway will be calculated. The void space above the 560’ elevation floor area north of the pedestal is also included in the calculations. The North Condenser Pedestal has identical void spaces below the water table.

Table 15 - South Condenser Pedestal Void Space to Water Table

Item	Length ft	Width ft	Height to Water Table ft	Total Volume per Item ft^3
S. Condenser Pedestal Above 572'	9.00	22.00	7.00	1386.00
S. Condenser Pedestal Above 572'	16.00	33.00	7.00	3696.00
S. Condenser Pedestal N 560' Floor	26.00	61.50	19.00	30381.00
			Totals	**35463**
N. Condenser Pedestal Above 572'	9.00	22.00	7.00	1386.00
N. Condenser Pedestal Above 572'	16.00	33.00	7.00	3696.00
N. Condenser Pedestal N 560' Floor	26.00	61.50	19.00	30381.00
			Totals	**35463**

The concrete volume of the South Condenser pedestal is the overall pedestal volume including the 7’8” thick floor below the 560’ elevation, minus the backfill volume and the keyway volume as shown in Table 16. The 7’8” thick floor of the area north of the pedestal and its 5 foot thick east wall are included in the volume estimate. The configuration is the same for the North Condenser pedestal area with the exception of the shorter length and absence of backfilled areas.

Table 16 - South Condenser Pedestal and North Floor Area and Wall Concrete Volumes

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
S. Condenser Pedestal	76.17	66.50	30.75	155758.13	1	155758.13
Small Backfill Volume	-12.50	38.00	20.17	-9580.75	1	-9580.75
Large Backfill Volume	-24.75	50.50	22.17	-27709.73	1	-27709.73
572' EL Keyway	-9.00	22.00	11.5	-2277.00	1	-2277.00
567' EL Keyway	-16.00	33.00	16.5	-8712.00	1	-8712.00
S. Cond Pedestal N 560; Floor	26.00	66.50	7.67	13261.43	1	13261.43
S. Con Ped N 560' Fl East Wall	26.00	28.00	5	3640.00	1	3640.00
			Total	**124380.08**	**Total**	**124380.08**
N. Condenser Pedestal	34.60	66.50	30.75	70752.68	1	70752.68
572' EL Keyway	-9.00	22.00	11.5	-2277.00	1	-2277.00
567' EL Keyway	-16.00	33.00	16.5	-8712.00	1	-8712.00
N. Cond Pedestal N 560; Floor	26.00	66.50	7.67	13255.67	1	13255.67
N. Con Ped S 560' Fl East Wall	26.00	28.00	5.00	3640.00	1	3640.00
			Total	**76659.34**	**Total**	**76659.34**

The remaining condenser pedestal area is the center Circulating Water Discharge Pedestal located over the Discharge Tunnel as shown in Figure 3, Figure 6, Figure 7, and Figure 13. As seen in Figure 6, the Discharge Pedestal is 49'6" long by 66'6" wide when the width of the 5'thick east wall is included. The lowest elevation is 562' which is 38' by 49'6" minus the surface areas of the four 8' by 7' pedestals. The calculated surface areas for the Center Discharge Condenser Support Pedestal are provided in Table 17.

Table 17 - Estimated Surface Areas for Center Discharge Area Condenser Pedestal

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Center Discharge Pedestal 562' Floor	49.50	38	1657	1	1657
Center Discharge Pedestal 580' 3/8" Pedestals	8.00	7	56	4	224
West Pedestal 588' Surface Area	49.50	14.00	693	1	693
East Pedestal 588' Surface Area	49.50	10.67	528	1	528
West Hallway Wall	49.50	28	1386	1	1386
West Pedestal Interior Wall	49.50	26	1287	1	1287
Center Discharge Pedestal 580' 3/8" Pedestals N&S Walls	8.00	26	208	8	1664
		Totals	**5815**		**7439**

The void space below the water table includes the 562’ surface area only since the tops of the four 7’ by 8’ pedestal are above the 579’ elevation. This is the surface area of 49.5’ by 38’ minus the four 7’ by 8’ pedestals times the height to the water table of 17 feet which equals 28,169 cubic feet.

The volume of concrete in the floor area of the center Pedestal is 49’6” by the 66’6” width times the 9’8” thickness of the floor minus the 5,505 cubic feet of discharge tunnel void space in Table 2.

Table 18 - Center Condenser Discharge Support Pedestal Concrete Volumes

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Center Discharge Pedestal 562' Floor	49.50	66.50	9.67	26315.52	1	26315.52
Center Discharge Pedestal 580' 3/8" Pedestals	7.00	8.00	26.00	1456.00	4	5824.00
West 588' Pedestal	49.50	14.00	26.00	18018.00	1	18018.00
East 588' Pedestal	49.50	10.67	26.00	13728.00	1	13728.00
			Total	**59517.52**	**Total**	**63885.52**

As shown in Figure 2, each unit has a Main Steam Tunnel that runs from the west end of the containments into the Turbine Building adjacent to the Diesel Generator Oil Storage Area at the 570’ elevation. The feedwater, main steam and other piping will be removed by removing the ceiling to the wall at the 588’ elevation. The details of the western portion of the Unit 1 Main Steam Tunnel are provided in Figure 16.

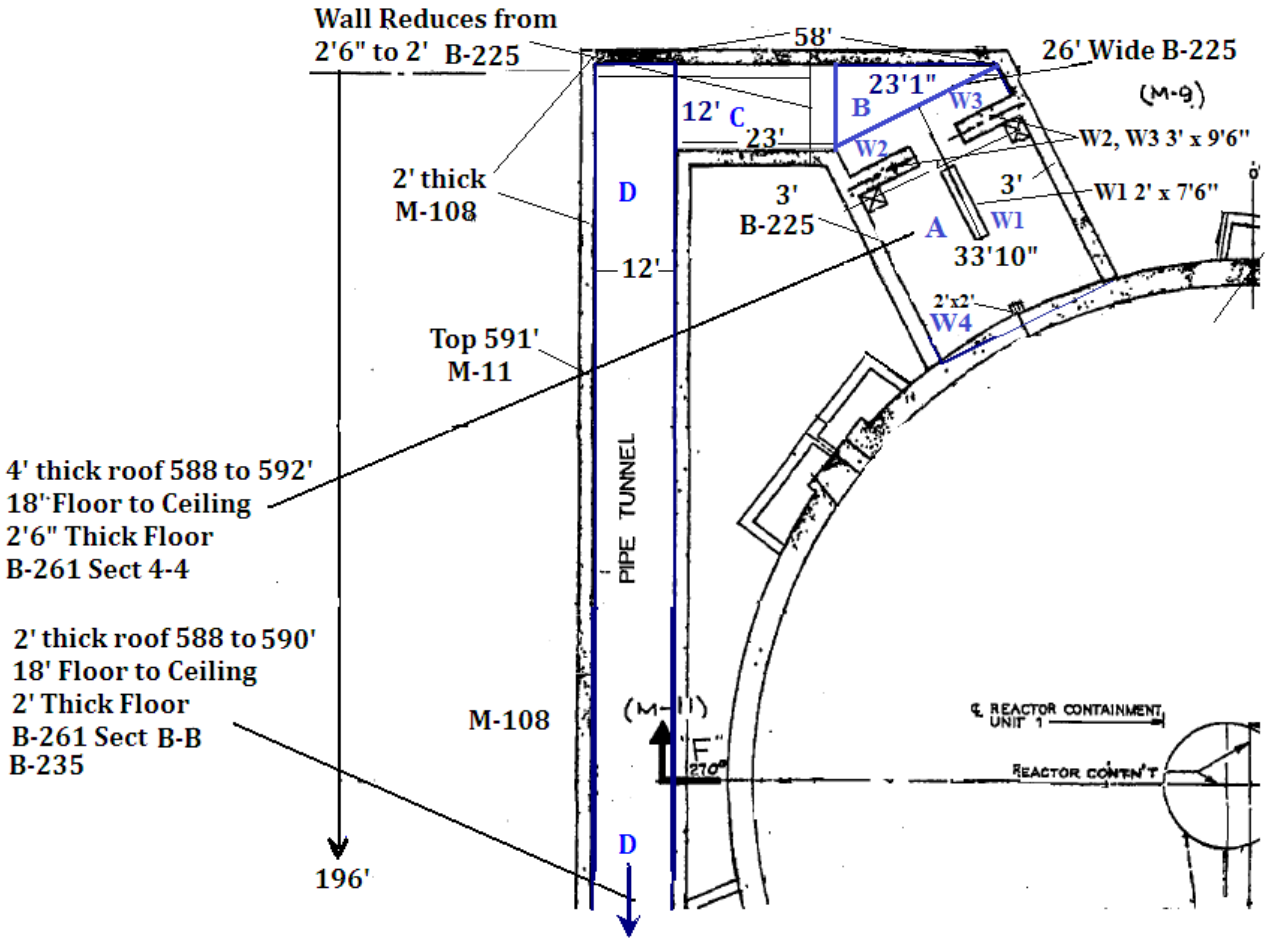


Figure 16 - Western Portion of Unit 1 Main Steam Tunnel

The calculated surface areas of the Main Steam Tunnel floors and walls are provided in Table 19.

Table 19 - Main Steam Tunnel Floor and Wall Surface Areas

Area	Length ft	Width ft	Surface Area ft^2	No Items	Total Surface Area ft^2
Section A Main Steam Floor	33.83	26	879.67	1	879.67
Section A Main Steam Walls	33.83	18	609	2	1218
W1 Sides	7.00	18	126	2	252
W1 Ends	2.00	18	36	2	72
W2 Sides	9.50	18	171	2	342
W2 End	3.00	18	54	1	54
W3 Sides	9.50	18	171	2	342
W3 End	3.00	18	54	1	54
W4 Beam Sides	2.00	18	36	2	72
Section B Main Steam Floor	23.08	6	138.5	1	138.5
Section B Main Steam Walls	23.08	18	415.5	1	415.5

Area	Length ft	Width ft	Surface Area ft^2	No Items	Total Surface Area ft^2
Section C Main Steam Floor	23.00	12	276	1	276
Section C Main Steam Walls	23.00	18	414	2	828
Section D Main Steam Floor	196.00	12	2352	1	2352
Section D Main Steam Walls	196.00	18	3528	2	6840
Section E Main Steam Floor	33.83	26	879.67	1	879.67
Section E Main Steam Walls	33.83	18	609	2	1218
W1 Sides	7.00	18	126	2	252
W1 Ends	2.00	18	36	2	72
W2 Sides	9.50	18	171	2	342
W2 End	3.00	18	54	1	54
W3 Sides	9.50	18	171	2	342
W3 End	3.00	18	54	1	54
W4 Beam Sides	2.00	18	36	2	72
Section F Main Steam Floor	7.83	26	203.67	1	203.67
Section F Main Steam Wall	15.80	18	284.40	1	284.40
Section G Main Steam Floor	75.50	20	1510.00	1	1510.00
Section G Main Steam Floor	34.35	2.5	85.89	1	85.89
Section G Main Steam Floor	2.00	12	24.00	1	24.00
Section G Main Steam West Wall	33.15	18	596.63	1	596.63
Section G East Main Steam Wall	75.50	18	1359.00	1	1359.00
Section H Main Steam Floor	64.25	20	1285.00	1	1285.00
Section H Main Steam West Wall	20.00	18	360.00	1	360.00
Section H Main Steam South Wall	44.25	18	796.50	1	796.50
Section H Main Steam North Wall	64.25	18	1156.50	1	1156.50
		Totals	**19058.91**		**25082.91**

As seen in Figure 16, Section A is 33’10” long by 26’ wide, with a 2’6” floor. Section B equals a rectangle surface area of 23’1” by 6 feet (e.g., half the width). The total length of Section D is 196 feet for the South wall and 196’ minus 12’ or 184’ for the North wall. The remaining Main Steam Tunnel configuration is shown in Figure 17.

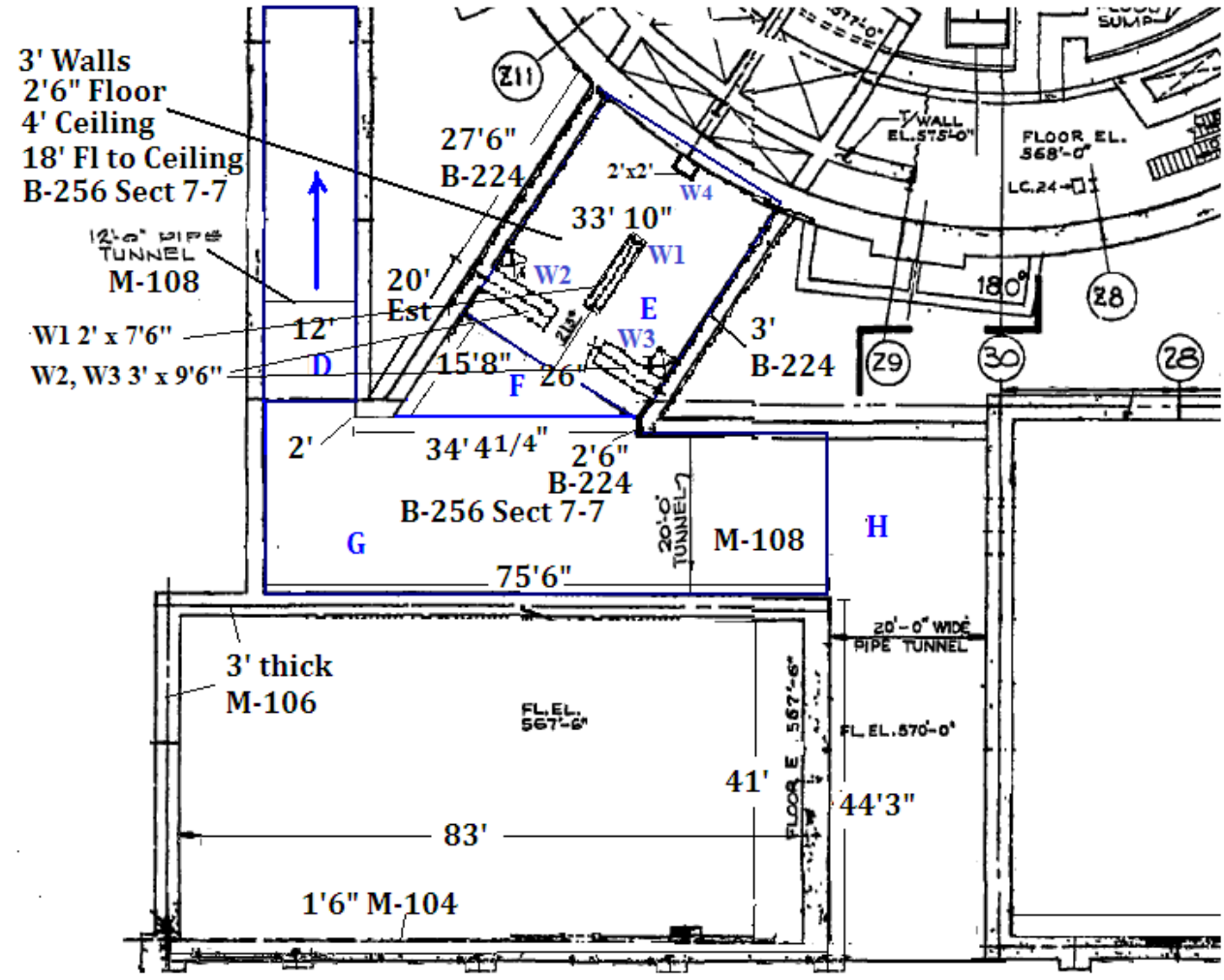


Figure 17 - Unit 1 East Section of Main Steam Tunnel

The surface area of the Section F floor is equal to the surface area of 1 7’10” (half the 15’8” wall) by 26’ rectangle. Section G includes the 2’6” setback for the west wall and the 2 foot setback for the point at which Section D ends.

Since the entire tunnel is at the 570’ elevation, the void space below the water table is the floor surface area times the 9 foot depth from the water table.

Table 20 - Unit 1 Main Steam Tunnel Void Space Below Water Table

Item	Length ft	Width ft	Height to Water Table ft	Total Volume per Item ft^3
Section A Main Steam Floor	33.83	26	9.00	7917.00
W1 Interior Wall	7.00	2.00	9.00	-126.00
W2 Interior Wall	9.50	3.00	9.00	-256.50
W3 Interior Wall	9.50	3.00	9.00	-256.50

Item	Length ft	Width ft	Height to Water Table ft	Total Volume per Item ft^3
W4 Beam	2.00	2.00	9.00	-36.00
Section B Main Steam Floor	23.08	6	9.00	1246.50
Section C Main Steam Floor	23.00	12	9.00	2484.00
Section D Main Steam Floor	196.00	12	9.00	21168.00
Section E Main Steam Floor	33.83	26	9.00	7917.00
W1 Interior Wall	7.00	2.00	9.00	-126.00
W2 Interior Wall	9.50	3.00	9.00	-256.50
W3 Interior Wall	9.50	3.00	9.00	-256.50
W4 Beam	2.00	2.00	9.00	-36.00
Section F Main Steam Floor	7.83	26	9.00	1833.00
Section G Main Steam Floor	75.50	20	9.00	13590.00
Section G Main Steam Floor	34.35	2.5	9.00	772.97
Section G Main Steam Floor	2.00	12	9.00	216.00
Section H Main Steam Floor	64.25	20	9.00	11565.00
			Totals	**67359**

The calculated concrete volumes for the floors include the wall thicknesses. The East Wall of Section G and the South wall of section H concrete volumes were included in the Diesel Generator Oil Storage Area calculation. The north wall of Section H was included in the Auxiliary Building calculation.

The Section B floor is ½ of the 12’ plus 2’6” West wall thickness or 7.25 feet since the floor area under the East wall is included in the Section A width. The section B wall thickness is 2’6”. The Section D North wall is the same as the South with the 12’ gap created by Section 6 subtracted.

Table 21 - Calculated Main Steam Tunnel Floor and Wall Concrete Volumes

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Section A Main Steam Floor	33.83	32	2.50	2706.67	1	2706.67
Section A Main Steam Walls	33.83	18	3.00	1827.00	2	3654.00
W1 Interior Wall	7.00	18	2.00	252.00	1	252.00
W2 Interior Wall	9.50	18	3.00	513.00	1	513.00
W3 Interior Wall	9.50	18	3.00	513.00	1	513.00
W4 Beam	2.00	18	2.00	72.00	1	72.00
Section B Main Steam Floor	23.08	7.25	2.50	418.39	1	418.39
Section B Main Steam Walls	23.08	18	2.50	1038.75	1	1038.75
Section C Main Steam Floor	23.00	12	2.50	690.00	1	690.00

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Section C Main Steam Walls	23.00	18	2.00	828.00	2	1656.00
Section D Main Steam Floor	196.00	16	2.50	7840.00	1	7840.00
Section D Main Steam Walls	196.00	18	2.00	7056.00	2	13680.00
Section E Main Steam Floor	33.83	32	2.50	2706.67	1	2706.67
Section E Main Steam Walls	33.83	18	3.00	1827.00	2	3654.00
W1 Interior Wall	7.00	18	2.00	252.00	1	252.00
W2 Interior Wall	9.50	18	3.00	513.00	1	513.00
W3 Interior Wall	9.50	18	3.00	513.00	1	513.00
W4 Beam	2.00	18	2.00	72.00	1	72.00
Section F Main Steam Floor	7.83	32	3.00	752.00	1	752.00
Section F Main Steam Wall	15.80	18	3.00	853.20	1	853.20
Section G Main Steam Floor	75.50	23	2.00	3473.00	1	3473.00
Section G Main Steam Floor	34.35	2.5	2.00	171.77	1	171.77
Section G Main Steam Floor	2.00	12	2.00	48.00	1	48.00
Section G Main Steam West Wall	45.15	18	2.00	1625.25	1	1625.25
Section H Main Steam Floor	68.25	20	2.00	2730.00	1	2730.00
Section H Main Steam Wall East	20.00	18	4.60	1656.00	1	1656.00
			Total	**40947.69**	**Total**	**52053.69**

The Common Area of the Turbine Building lies between each Unit 1 and 2. It contains a large sump as seen in Figure 18.

Table 22 - Common Area Floor and Wall Surface Areas

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Common Area Floor minus Fire Sump	137.50	103.83	13818.08	1	13359.08
Common Area West Wall	137.50	28	3850.00	1	3850.00
Common Area East Wall	49.00	28	1372.00	2	2744.00
Oil Room Floor	47.60	38	1808.80	1	1808.80
Oil Room North and South Walls	34.00	28	952.00	2	1904.00
Oil Room East Wall	39.50	28	1106.00	1	1106.00
Fire Sump Floor	19.13	24	459.00	1	459.00
Fire Sump Walls N&S to 549'4" EL	19.13	10.67	204.00	2	408.00
Fire Sump Walls E&W to 549'4" EL	24.00	10.67	256.00	2	512.00
Fire Sump Pump Area Walls Interior 549'4" EL	4.00	10.67	42.67	3	128.00
Fire Sump Pump Area Walls Exterior 549'4" EL	5.00	10.67	53.33	2	106.67

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Fire Sump Pump Area Walls Exterior 549'4" EL	6.00	10.67	64.00	1	64.00
Fire Sump Walls N&S to 540'4" EL	7.00	9.00	63.00	2	126.00
Fire Sump Walls E&W to 540'4" EL	7.00	9.00	63.00	2	126.00
		Totals	**24111.88**		**26701.55**

The sump interior is 19’1.5” wide and 24’ long. There is a 7’ by 7’ opening below which the sump floor is at 540’4”. The rest of the sump is at 549’4” and is covered by a 2’8” thick slab. It is assumed the slab will be removed in the end state to create access to the sump. There is a 4’ by 4’ portion of the sump enclosed by one foot thick walls. The surface areas for the elevator pit, valve pits and other sumps were not included in the estimated surface areas, void space or concrete volume calculations.

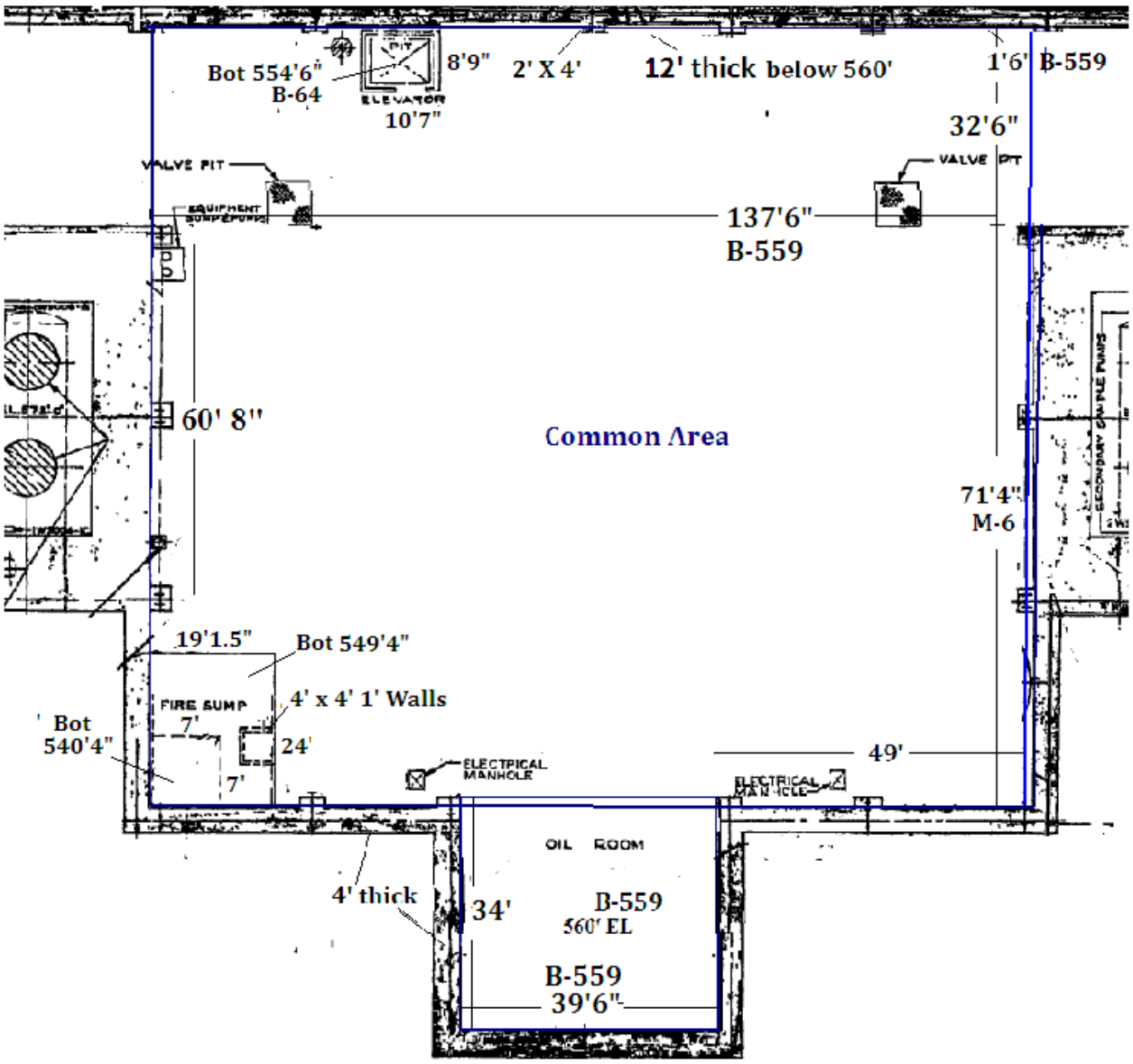


Figure 18 - Turbine Building Common Area and Oil Room

The void space to the water table included the fire sump volume and the volume taken up by the 29 2' by 4' by 2' support columns along the common wall with the Auxiliary Building and the Common Area South, East and North Walls was subtracted from the void space volume. For conservatism the void space volume of the elevator pit other valve pits and sumps were not included in the void space volume. The calculated void space volumes for the Common Area are provided in Table 23.

Table 23 - Common Area Void Space Volumes Below Water Table

Item	Length ft	Width ft	Height to Water Table ft	Total Volume per Item ft^3
Common Area	137.50	103.83	19.00	271264.58
Oil Room	39.50	38	19.00	28519.00
Fire Sump	19.13	24	10.67	4896.00
Fire Sump	7.00	7	9.00	441.00
29 Columns On Interior Walls	-2.00	8	19.00	-8816.00
			Totals	**305121**

As seen in the upper sketch of Figure 3 the floor is thicker under the Common Area and under approximately 65.25 feet of the Unit 1 West Hallway along the 262' length of the Auxiliary Building wall. The floor also increases in thickness at the transition to the Auxiliary Building basement as seen in Figure 19.

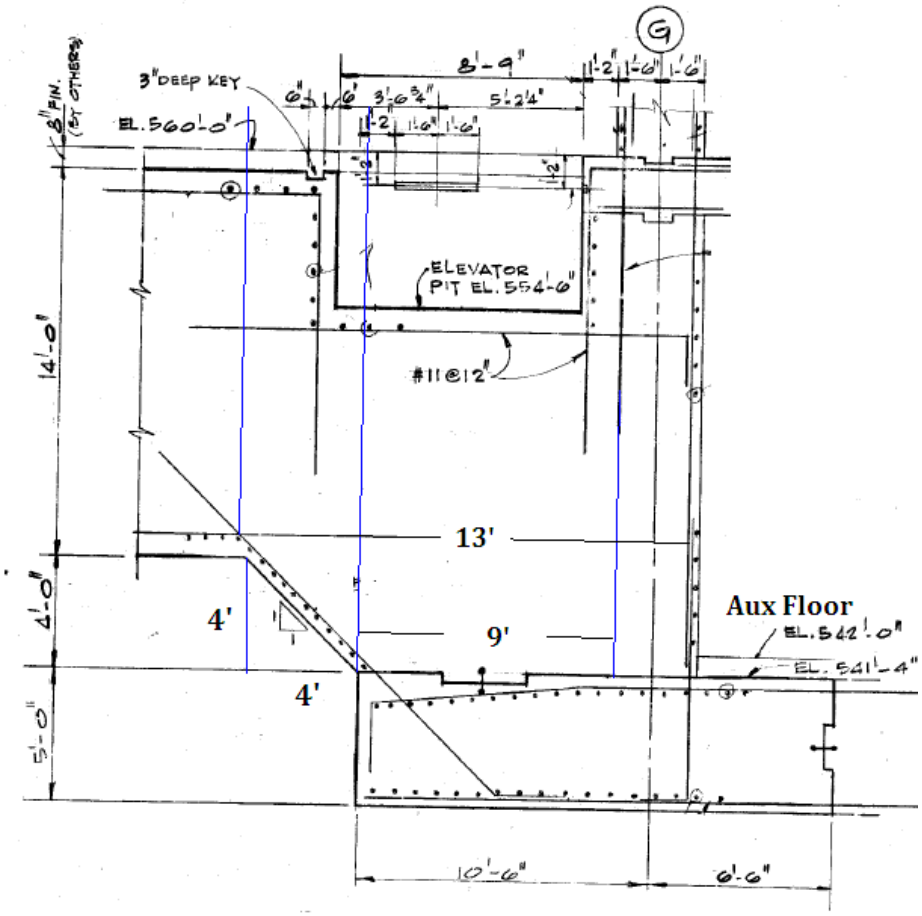


Figure 19 - Common Area Floor and Transition to Auxiliary Building Floor Thickness

This extends approximately 13 feet under the Common Area and West Hallway Area floors. An additional 4 feet is added to the length of the Common Area to account for portions of the floor

under the wall. The calculated concrete volumes of the Common Area floors and walls and of the increased slab thickness are summarized in Table 24.

Table 24 - Common Area Calculated Concrete Volumes

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Common Area Floor	137.50	107.83	14.67	217463.89	1	217463.89
Common Area East Wall	49.00	28	4.00	5488.00	2	10976.00
Oil Room Floor	47.50	38	14.67	26473.33	1	26473.33
Oil Room North and South Walls	34.00	28	4.00	3808.00	2	7616.00
Oil Room East Wall	39.50	28	4.00	4424.00	1	4424.00
Fire Sump Floor Void	19.13	-24	10.67	-4896.00	1	-4896.00
Fire Sump Floor Void	7.00	-7	9.00	-441.00	2	-882.00
Fire Sump Pump Area Walls Exterior 549'4" EL	4.00	4.00	1.00	16.00	2	32.00
Fire Sump Pump Area Walls Exterior 549'4" EL	6.00	4.00	1.00	24.00	2	48.00
Total Columns On Interior Walls	2.00	4	28.00	224.00	29	6496.00
Slope Along Wall G	262.79	10.85	4	11409.54	1	11409.54
Five Foot Slab Along Wall G	262.79	8.85	5	11634.01	1	11634.01
Overlap Under Unit 1	62.65	32.50	7	14251.93	1	14251.93
			Total	**289879.69**	**Total**	**305046.69**

The void space created by the Fire Sump was subtracted from the volume and the additional volume created by the twenty nine 2’ by 4 foot columns that extend 28 feet from the 588’ to 560’ were included in the concrete volume.

Table 25 - Summary of Turbine Building Surface Areas, Water Table Void Spaces and Concrete Volumes

Item	Total Surface Area ft^2	Total Water Table Void Volume per Item ft^3	Total Concrete Volume per Item ft^3
Unit 1 Discharge Tunnel	26214	105650	115859
Unit 1 Diesel Oil Storage	8264	36570	41645
Unit 1 West Hallway	10790	104512	46808
Unit 1 S. Condenser Pedestal	10209	35463	124380
Unit 1 N. Condenser Pedestal	7467	35463	76659
Unit 1 Center Discharge Pedestal	7439	28169	63886
Unit 1 Main Steam Tunnel	25083	67359	53332
Common Area	26702	305121	305047
Unit 2 Discharge Tunnel	26214	105650	115859
Unit 2 Diesel Oil Storage	8264	36570	41645
Unit 2 West Hallway Floor	10790	104512	46808
Unit 2 S. Condenser Pedestal	10209	35463	124380
Unit 2 N. Condenser Pedestal	7467	35463	76659
Unit 2 Center Discharge Pedestal	7439	28169	63886
Unit 2 Main Steam Tunnel	25083	67359	53332
Total TB Void Space	**2.18E+05**	**1.13E+06**	**1.35E+06**
Without Discharge Tunnel	1.65E+05	9.20E+05	1.12E+06

3.2. Crib House

The Crib House is located east of the Turbine Building and houses the Circulating Water Pumps and Service Water Pumps. As seen in Figure 20 and Figure 22, the lower elevation of the Crib House is open to the Forebay where the Unit 1 and Unit 2 Circulating Water Intake Pipes and the Ice Melting Lines are located.

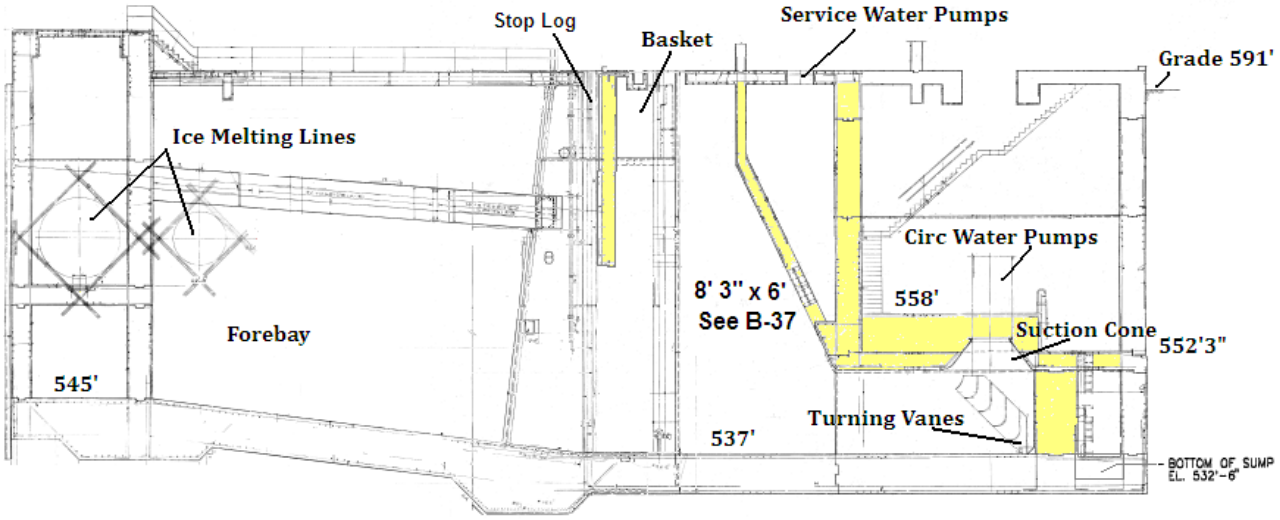


Figure 20 - Crib House and Forebay Below Grade Side View

Since end state will require removal of all materials above the 588' elevation and only structural materials and embedded piping and components can remain. The Service Water Pumps, Circulating Water Pumps and the associated interior structures will be removed. The overall layout is shown in Figure 20. The yellow highlighted walls are interior walls whose surface areas and volumes are calculated separately and then subtracted from the water table void space. As seen in Figure 21, there are flow splitters that also constitute interior walls highlighted in yellow.

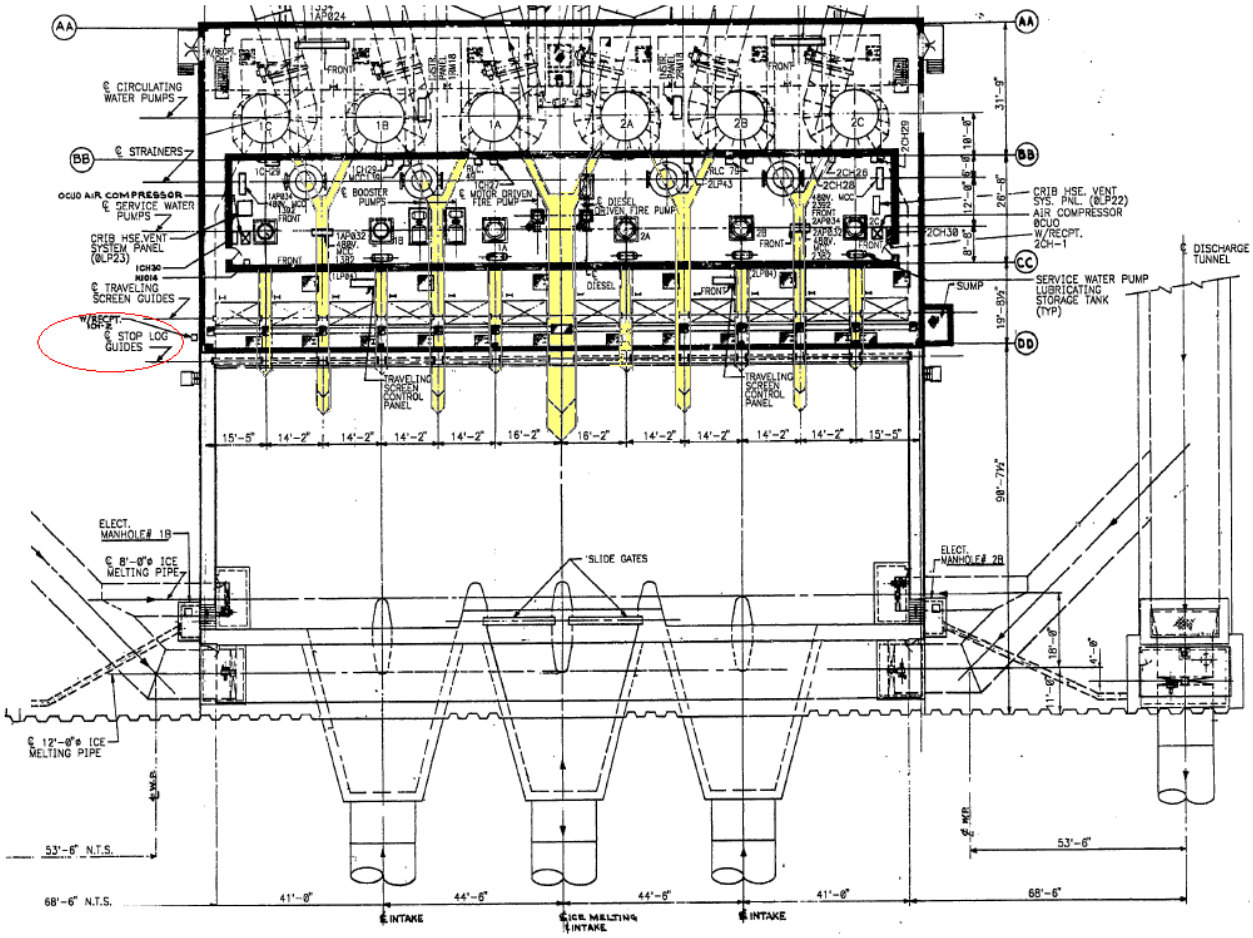


Figure 21 - Overhead View of Crib House and Forebay Showing Flow Splitter Interior Walls

Figure 22 shows the hollowed out structure that will be used to calculate the surface area, concrete volume and void space of the overall shell with no interior floors or walls. Then the interior floor and wall surface areas, concrete volumes will be calculated and added to the shell totals. The concrete volumes below the water table will be subtracted from the void space.

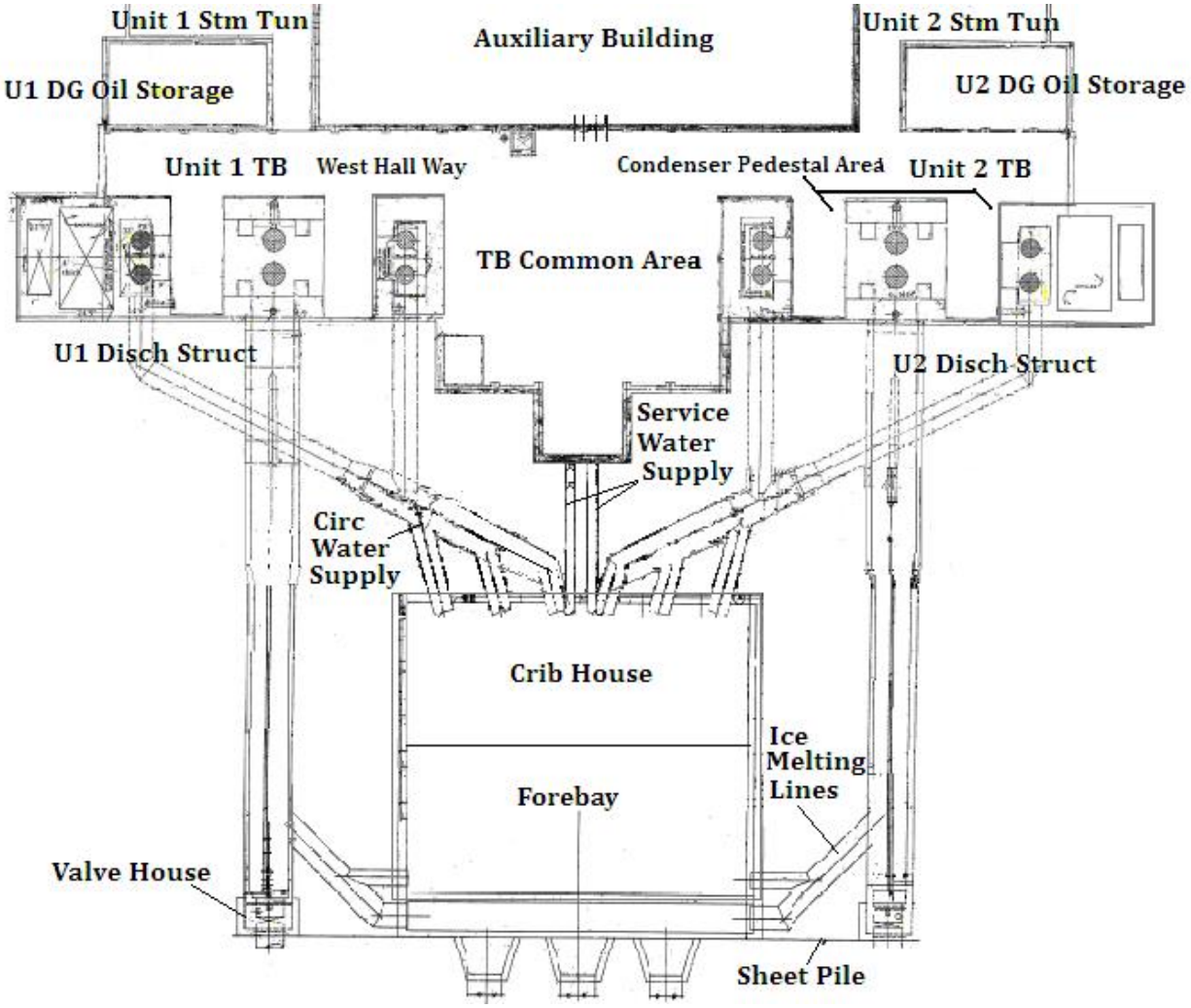


Figure 22 - Crib House and Forebay Overhead View.

Pipes will be cut at the wall penetrations and those that are buried and will remain such as the Service Water Header and Circulating Water pipes will be plugged to prevent communication with the Forebay and end state structures such as the Discharge Tunnels, Turbine Building and Auxiliary Building. The top view dimensions are shown in Figure 23.

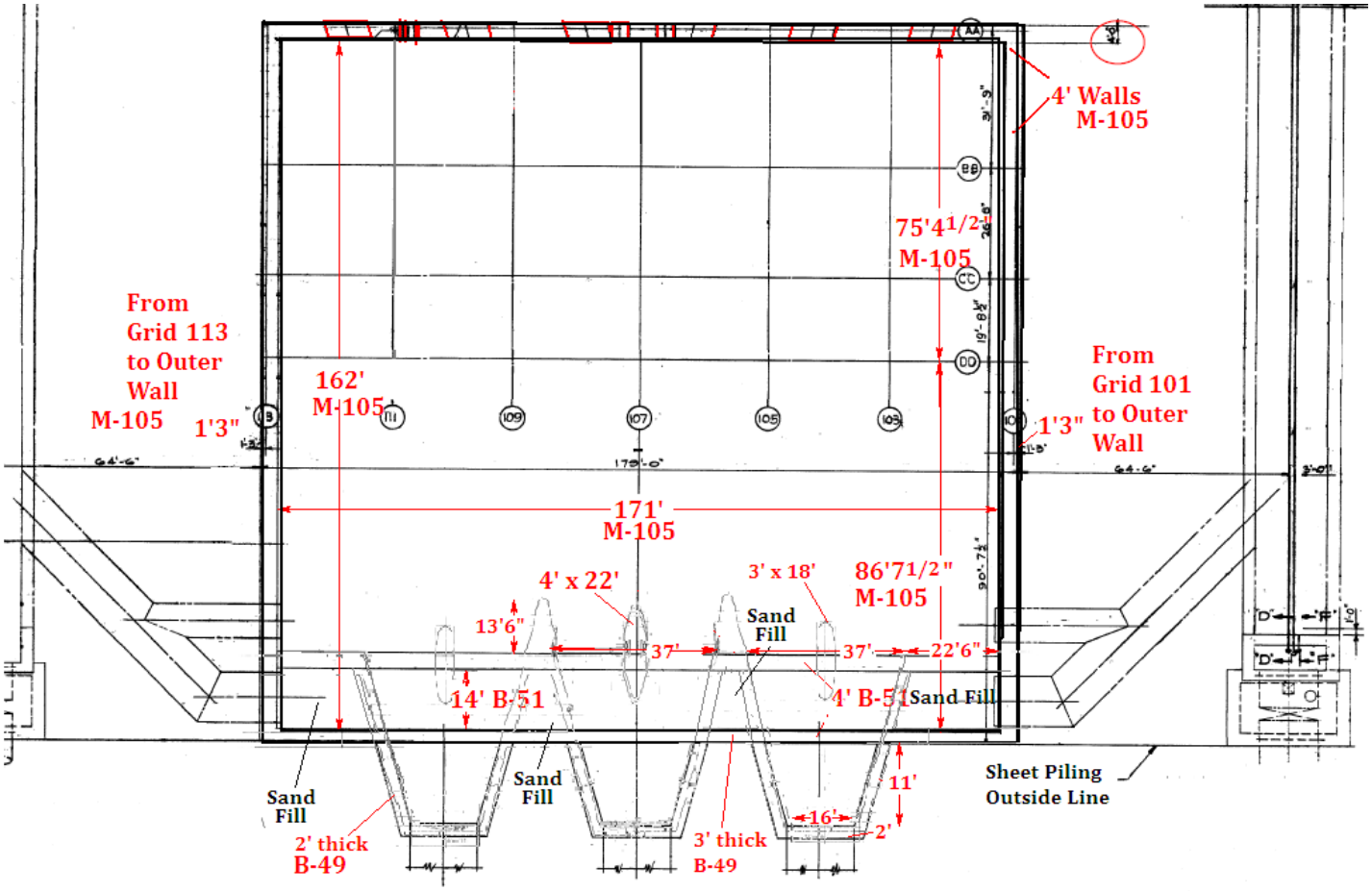


Figure 23 - Crib House and Forebay Top View Dimensions

The side view dimensions of the Forebay are provided in Figure 25. This shows a lower section with a floor at the 545' elevation that is 16 feet high. As seen in Figure 23 and Figure 24, 545' elevation consists of three fan shaped openings with flow splitting concrete structures in the middle of them. The calculated surface areas for the 545' elevation of the Forebay intake structure are summarized in Table 26. As seen in Figure 24 the fan shaped floor areas surface area is equal to a 26'6" by 32 foot rectangle. The north and south walls of each fan are the square root of 32' squared and 10'6" squared or 33.68'. At a 16' height each walls surface area is 538.86 square feet. There are two center points that extend four of the six north and south fan walls past the interior of side of the east wall of the Forebay. This additional wall length is the square root of 13'6" squared plus 3'9" squared or 14.01 feet when multiplied by the 16 foot height the surface area is 224.18 square feet for the additional length of each of these four sides.

There are two side and one center flow splitters. Each flow splitter consists of a rectangular center section and east and west triangular point. As seen in Figure 24, the wall between the triangular sections is 4 feet wide by 16 feet high. The length of the triangular walls are the square root of 7' squared plus 2.5' squared or 7.43 feet. This equals a surface area of 119.93 square feet for each side of the east and west points of the diamond. The walls between the triangular sections of the center flow splitter has center side 8'2.25" by 16 feet high for 131 square feet per side. The east and west points have the same 7' by 2.5' dimensions as the points on the side flow splitters.

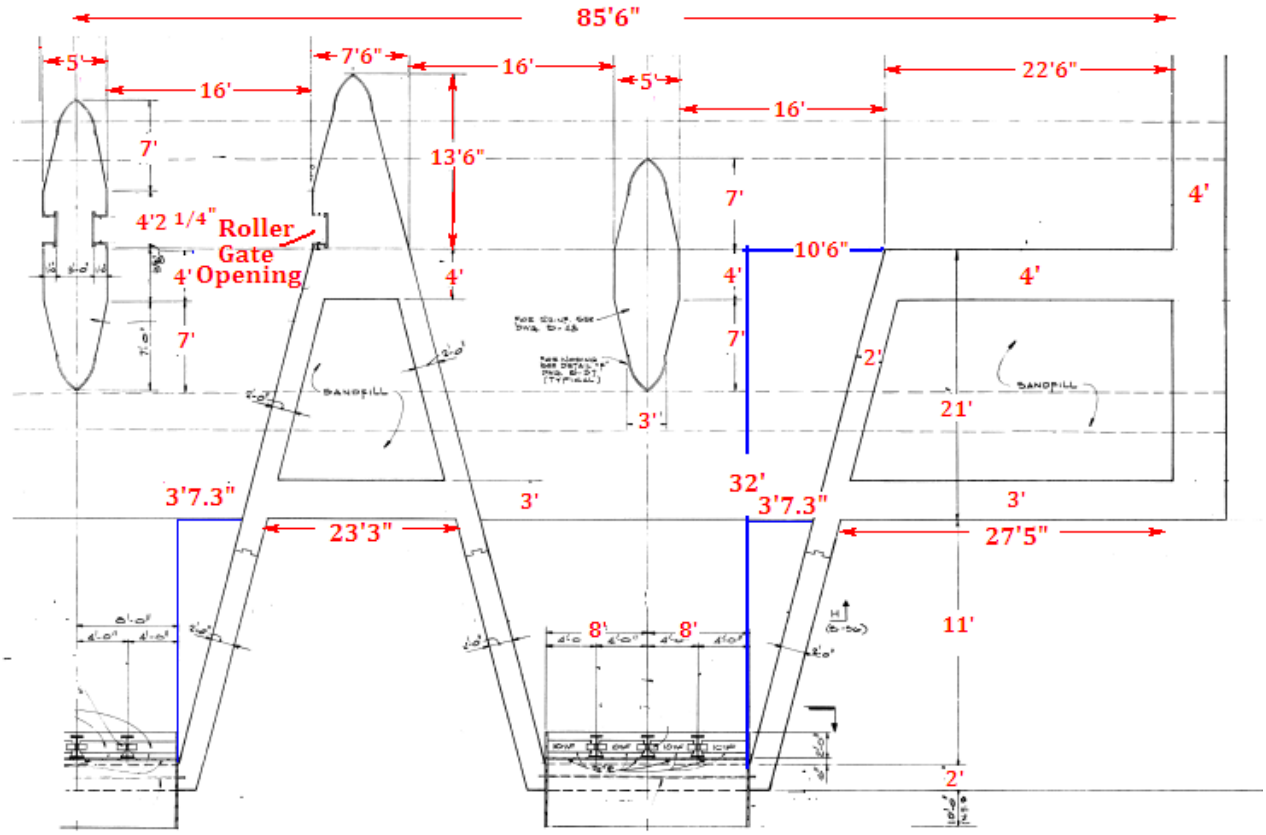


Figure 24 - Top View of Forebay 545' Elevation

The remaining interior surface areas consist of the 16’ by 16’east wall of the fan that will be formed when the Circulating Water intake pipes are grouted closed and the 22’6” section on the north and south sides of the structure.

Table 26 - Forebay 545' Elevation Intake Structure Surface Areas

Area	Length ft	Width ft	Surface Area ft^2	No Items	Total Surface Area ft^2
Side Intake Floor	26.5	32	848	3	2544
Intake Wall N&S Walls	33.68	16	538.86	6	3233.1
Center Point	14.01	16	224.18	4	896.7
Side Flow Splitter	4	16	64.00	4	256.0
Side Flow Splitter Points	7.43	16	118.93	8	951.4
Center Flow Splitter	8.19	16	131.00	2	262
Center Flow Splitter Points	7.43	16	118.93	4	475.7
Intake East Wall Plugged Pipe	16	16	256	3	768
West Wall Interior	22.5	16	360.00	2	720.0
		Totals	**2659.89**		**10107**

The void space created by the fan shaped intakes is below the 579' water table. The volume taken up by the south, center and north flow splitters is subtracted from the fan shaped volume as seen in Table 27.

Table 27 - Forebay 545' Intake Structure Void Space Below 579' Water Table

Item	Length ft	Width ft	Height to Water Table ft	Total Volume per Item ft^3
Three Intake Areas	26.50	32.00	16.00	40704.00
South Flow Splitter	-5.00	11.00	16.00	-880.00
Center Flow Splitter	-5.00	15.19	16.00	-1215.20
North Flow Splitter	-5.00	11.00	16.00	-880.00
			Totals	**37729**

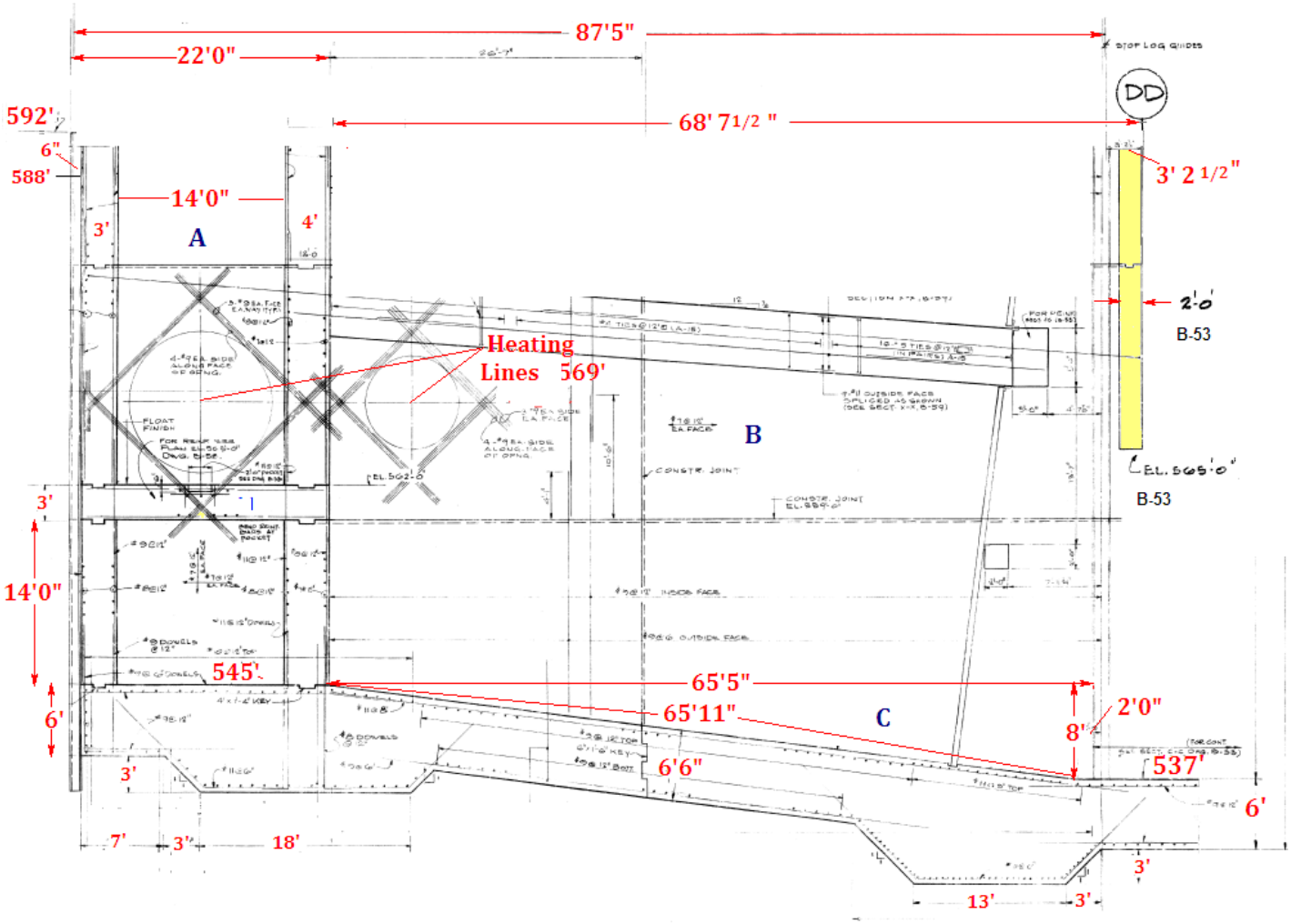


Figure 25 - Side View of Forebay with Dimensions

As seen in Figure 25, the floor under the 545' intake structure is 9' thick minus the 7' by 3' and 1.5' by 3' sections. The floor length and width, including the foot print under the walls is 179' long by 21' wide. The volume is 179' by 21' by 9' minus the 179' x 3' by 8.5' area or 29,699.25 cubic feet. The north and south walls of each fan shaped opening are 2 feet thick equaling 1,077.72 cubic feet of concrete per wall. The volume of the center points of the two fans which extend past the interior wall 13'6" by 3'9" by 16' each. The volumes of the flow splitters were described above. The west portion of the interior wall is 4 feet thick and is split into 4 parts by the fan shaped openings. The south and north portions are 22.5' by 4' by 16' high. There is an approximately 4' by 5' by 16' section in each of the two center points on either side of the center fan shaped opening.

The east wall is 3 feet thick and has a north and south section 27'5 inches long by 16' high. There are two 23'3" long sections adjacent to the center fan shaped opening. There is also the 16' by 16' by 2' thick wall formed once the 16' diameter Circulating water pipes are sealed at the east side of each fan shaped opening. The calculated concrete volumes for the 545' section of the Forebay intake structure are shown in Table 28.

Table 28 – Forebay 545' Intake Structure Estimated Concrete Volumes without Interior Structures

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Intake Area	21.00	179.00	9.00	29669.25	1	29669.25
N&S Walls	33.68	16.00	2	1077.72	6	6466.30
Center Points	13.50	16.00	3.75	810.00	2	1620.00
South Flow Splitter	5.00	11.00	16.00	880.00	2	1760.00
Center Flow Splitter	5.00	15.19	16.00	1215.20	4	4860.80
North Flow Splitter	5.00	11.00	16.00	880.00	1	880.00
West Wall Interior	22.50	16.00	4	1440.00	2	2880.00
Center Point West Wall	4.00	16.00	5	320.00	2	640.00
East Wall Ends	27.42	16.00	3	1316.00	2	2632.00
East Wall Interior	23.26	16.00	3	1116.40	2	2232.80
Intake East Wall Plugged Pipe	16	16	2	512.00	3	1536.00
			Totals	**39236.57**		**55177.15**

As seen in Figure 25, there is a floor above the fan shaped intakes at the 562' elevation. This floor is 14' by 171' or 2394 square feet as seen in Table 29. The walls extend from 588' to 562' or 26' and creates an interior void space below the 570' water table of 14' by 171' by 17' or 40,698 cubic feet as seen in Table 30. Twenty seven feet of the interior wall in the Forebay above the fan shaped openings was not included in the 545' elevation section which went to a height of 16 feet. The remaining surface area of the east Forebay interior wall is 171' by 27' or 4,617 cubic feet.

Table 29 - Forebay Intake Structure Surface Areas Above 562' Elevation without Interior Structures

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Forebay Intake 562' Floor	14	171	2394	1	2394
Forebay Intake 562' Interior N&S Walls	14	26	364	2	728
Forebay Intake 562' Interior E&W Walls	171	26	4446	2	8892
Forebay Intake 562' Exterior W Wall	171	27	4617	1	4617
		Totals	**11821**		**16631**

Table 30 - Upper Forebay Intake Structure Void Space Below 579' Water Table without Interior Structures

Item	Length ft	Width ft	Height to Water Table ft	Total Volume per Item ft^3
Forebay Intake 562'	14	171	17	**40698**

The concrete volume of the upper floor is 21’ wide by 179’ long and 3 feet thick equaling 11,277 cubic feet as seen in Table 31.

Table 31 - Forebay Upper Intake Structure Concrete Volumes without Interior Structures

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Forebay Intake 562' Floor	21	179	3.00	11277	1	11277
Forebay Intake 562' Interior N&S Walls	26	14	4.00	1456	2	2912
Forebay Intake 562' E Wall	26	179	3.00	13962	1	13962
Forebay Intake 562' W Wall	26	179	4.00	18616	1	18616
			Totals	**45311.0**		**46767.0**

As seen in Figure 25, the Forebay floor drops 8 feet in elevation from the 545’ to the 537’ elevation. The floor is 65’11 inches long by 171’ wide for a surface area of 11,271.75 square feet. The north and south walls extend from the 588’ to a mean elevation of 541’ or 47’ such that each wall has a surface area of 3,078.5 square feet. As seen in Figure 26 the floor of the Crib House extends 79’11” to the west wall, resulting in a 13,665.75 square foot surface area. The north and south walls extend from 588’ to 537’ or 51’ resulting in a surface area of 4,075.75 square feet per wall. The west wall once all the penetrations are sealed will have a surface area of 51’ by 171’ or 8,721 square feet as seen in Table 32.

Table 32 - Forebay and Crib House End State Surface Areas without Interior Structures

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Forebay Floor	65.92	171	11271.75	1	11271.75
Forebay South & North Walls	47	65.50	3078.50	2	6157.00
Crib House Floor	79.92	171	13665.75	1	13665.75
Crib House South & North Walls	51	79.92	4075.75	2	8151.50
Crib House West Wall	51	171.00	8721.00	1	8721.00
		Totals	**40812.75**		**47967.00**

The void space below the water table for the Forebay and Crib House are shown in Table 33.

Table 33 - Forebay and Crib House Void Space Below 579' Water Table without Interior Structures

Item	Length ft	Width ft	Height to Water Table ft	Total Volume per Item ft^3
Forebay	65.50	171	38	425619.00
Crib House	79.92	171	42	573961.50
			Totals	**999581**

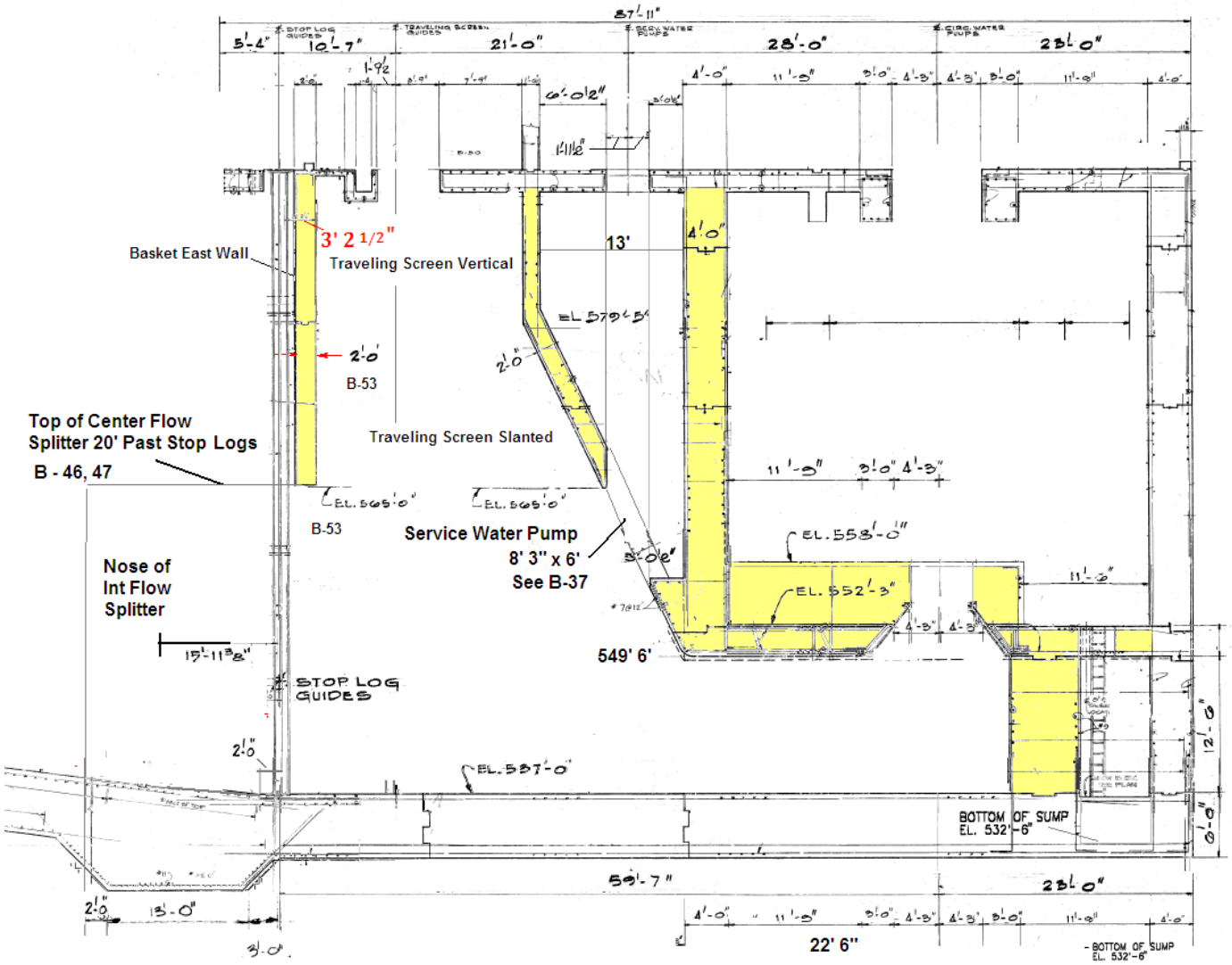


Figure 26 - Crib House End State Side View

As seen in Figure 25, most of the sloped Forebay floor is 6'6" thick with the exception of a small section that is 9' thick and 4'6" long near the Forebay intake structure. The bevel is 2'6" by 2'6" such that the additional volume of this small section equals 9' minus 6'6" or 2'6" thick by 5'9" long and 179' wide or 2,573 cubic feet. The Forebay floor is 65'11" long by 179' wide and 6'6" thick or 73,266 cubic feet. The additional volume at the seam where the Forebay floor meets the Crib House floor is approximated by a rectangle 16' by 179' by 3'6" thick. The Crib House floor is 6 feet thick and the walls are 4 feet thick.

Table 34 - Forebay and Crib House End State Concrete Volumes without Interior Structures

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Additional Volume for Forebay 9' Thick Section	5.75	179	2.50	2573	1	2573
Forebay Floor	65.92	179	6.50	76694	1	76694
Additional Crib House Steam Volume	16	179	3.50	10024	1	10024
Forebay South & North Walls	47	65.50	4.00	12314	1	12314
Crib House Floor	83.92	179	6.00	90127	1	90127
Crib House South & North Walls	51	83.92	4.00	17119	1	17119
Crib House West Wall	51	171.00	4.00	34884	1	34884
			Totals	**243734.7**		**243734.7**

The Forebay and Crib House end state surface areas, void space below the water table and concrete volumes are summarized

Table 35 - Summary of Crib House & Forebay Surface Areas, Water Table Void Space and Concrete Volumes without Interior Structures

Item	Total Surface Area ft^2	Total Water Table Void Volume per Item ft^3	Total Concrete Volume per Item ft^3
Forebay Intake Structure 545'	10107	37729	55177
Forebay Intake Structure 562'	16631	40698	46767
Forebay and Crib House End State	47967	999581	243735
Total Crib House Void Space	**7.47E+04**	**1.08E+06**	**3.46E+05**

The surface areas and concrete volumes of the interior walls and floors will be added to the Table 35 values. The surface area parameters and calculated surface areas of the internal walls and floors are provided in Table 36, concrete volumes are in Table 37. The calculation described below resulted in an additional 73,812.5 square feet above the 74,705 square feet calculated for the area with no interior walls. This is a factor of 1.99 higher than the hollowed out structure.

As seen in Figure 26, the basket wall behind the stop log guide is 25 feet tall from the 588 foot to the 565 foot elevation. Figure 21 and Figure 23 show that it spans the entire 171' foot interior width of the forebay. This equals a 3,933 square foot surface area for each side or 7,866 square feet total. Fourteen feet is below the 570 foot elevation water table and the wall is 2 feet thick creating a void space of 4,788 cubic feet that will have to be subtracted from the overall void space volume if the wall remains in the end state. The overall concrete volume is 7,866 cubic feet of concrete.

As seen in Figure 22, there are also Circulating Water Pump intake flow splitters that have surface areas and volumes that need to be calculated if they remain in the end state. As seen in Figure 22**Error! Reference source not found.** there is a common splitter between Units 1 and 2 and each unit has three channels that are the same for Unit 1 and Unit 2. The details of the Unit 1 channel and flow splitter layout are provided in Figure 27.

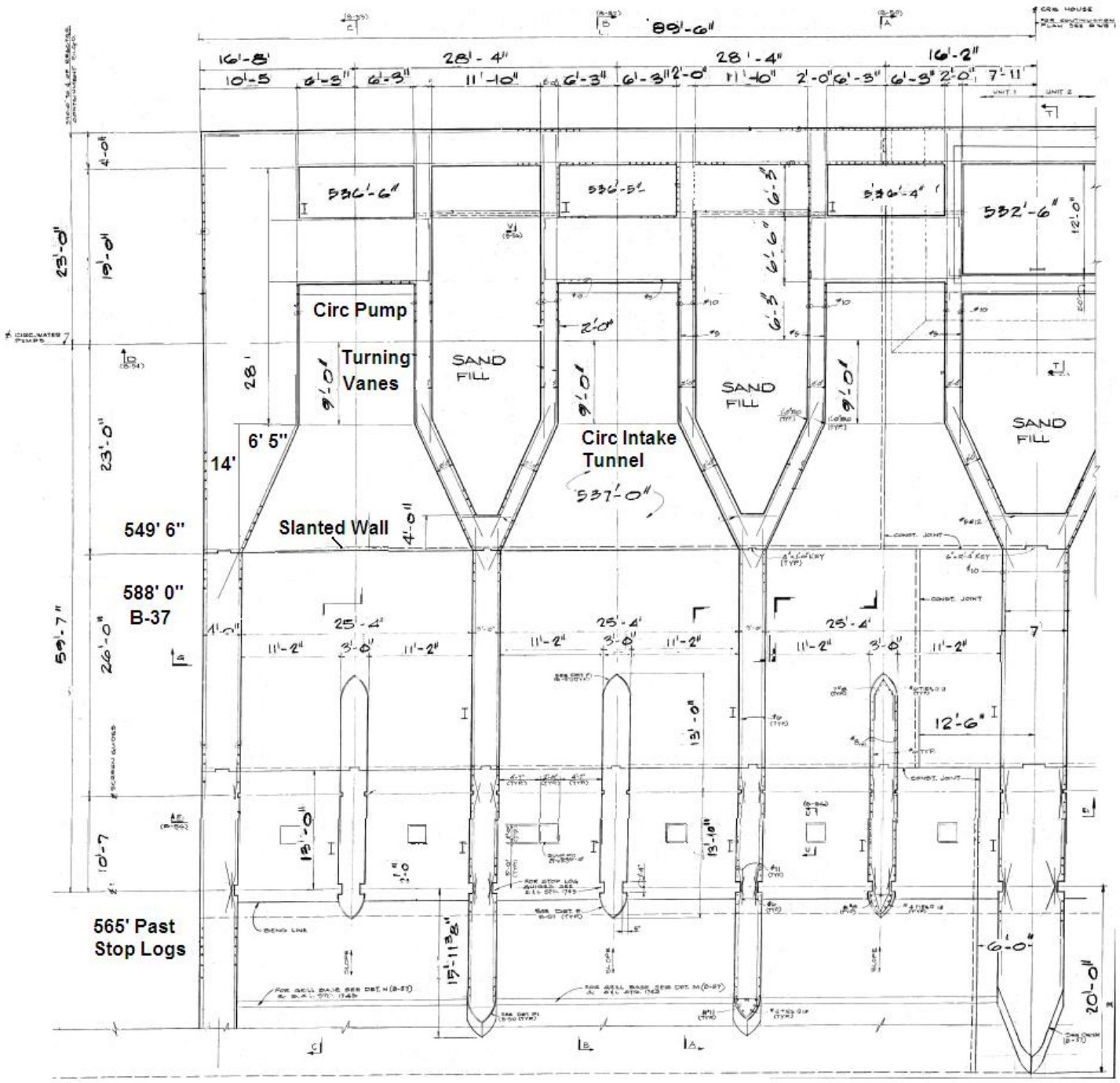


Figure 27 - Top View Unit 1 Flow Splitters from B-46

The portions of the splitter walls past on the Forebay side (East Side) of the Stop Logs extend from the 537' floor elevation to the 565 foot elevation or 28 feet. As seen in the case of the Common splitter on the right of the figure, it extends 20 feet past the stop log guide resulting in a side surface area of 560 square feet per side. The top is 7 feet wide resulting in a surface area of 140 square feet and a concrete volume of 3920 cubic feet that must be subtracted from the void space below the water table.

There is a center flow splitter in each of the three channels whose height is at the 565 foot elevation. There are three per unit or 6 total. Each splitter is 13 feet long and 28 feet high equaling a surface area of 364 square feet per side or 4,368 square feet for all 12 sides. Each center flow splitter is 3 feet wide resulting in a top surface area of 39 square feet which is 234 square feet for all 6 center flow splitters. The concrete volume is 1,092 cubic feet per center flow splitter or 6,552 square feet for all 6. This volume is subtracted from the volume below the water table.

There are two flow splitters per unit that are 15' 11 3/8" (15.95 feet) long past the stop logs. At 28 feet high per side this equals 446.54 square feet per side or 3,572 square feet for both units. Drawing B-46 and B-47 show the tunnel flow splitters to be 3 feet thick for 47.84 square feet per top portion that is past the stop locks equaling 191.38 square feet for both units. This equals 1,339.63 cubic feet per channel flow splitter or 5,358.5 for all four. This volume will be subtracted from the overall void space if they are left in place.

The portions of the common and channel flow splitters inboard of the stop logs (West) to the Circ Water Pump tunnel intake at the slanted wall extend to the 588 foot elevation or 51 feet high. The distance from the stop logs to the pump intake tunnel is 36' 6". This equals 1,861.5 square feet per side for the common flow splitter and top surface area of 255.5 square feet. The concrete volume of the common flow splitter west of the stop logs is 13,030.50 cubic feet or which 10,731 cubic feet is below the water table.

The two channel splitters per unit are 3 feet thick and extend the same distances and elevations on the west side of the stop log to the circulating pump intake tunnel, also equaling 1.861.5 feet per side or 14, 892 square feet for all 8 sides for both units. The channel splitters are 3 feet thick equaling a total top surface area of 438 square feet for all four. The volume of each is 5584.5 cubic feet or 22338 cubic feet for all four of which 18,648 is below the water table.

Each of the three channels has a slanted wall this 25' 4" wide. As seen in Figure 26, the slanted portion of the wall is from 579' 3" to 552' 3" or a 27 foot drop. The base of the triangle is 13 feet across as determined by dimensions on drawing B-53. The hypotenuse is 29.97 feet. The straight piece is 599 to 579'3"or 8.25 feet long. The surface area of the straight portion of each channel is 221.67 square feet per side with each of the 6 tunnel total have an interior and exterior surface this is 2,660 square feet for both units. Each slanted portion of the channel has a surface area of 759.16 square feet minus the 49.38 square feet of the 8'3" by 6' service water pump openings or 709.78 square feet for a total of 8,517.3 square feet for all 12 sides of both units. Each wall is 2 feet thick resulting making the volume of the concrete 29.97 puss 8.75 or 38.72 feet by 25.33 feet by 2 feet minus 49.38 square feet by 2 feet for the opening which equals 1862.88 cubic feet per tunnel or 11,177.3 cubic feet for all six tunnels. Nine feet of the wall is above the water table making the length below the water table 29.72 feet resulting in 9,626.42 cubic feet below the water table.

The side walls and the back walls of the Service Pump areas also have surface areas requiring calculation. As seen in Figure 26, the sides of the Service Pump housing have rectangular section 13 feet deep by 8.75 feet or 113.75 square feet per side which is 1365 square feet for all 12 side areas. The concrete volume is an extra 2 feet wide on the front and 4 feet wide on the back. The four tunnel flow splitting walls are three feet thick. The rectangular side walls are 3 feet thick for a concrete volume of 840 cubic feet per wall or 3360 cubic feet for all four for both units. The Common splitter wall rectangular portion is 13 by 8.75 by 7 feet thick or 367.5 cubic feet of

concrete. Since the 8.75 feet goes to the 579’ 3” and the water table is at the 579’ none of this volume is in the water table.

As seen in Figure 26, the triangle section extends from approximately 579’ 3” to 553’ 3” or 26 feet. It has a 13 foot base, making the surface area ½ 26 by 13 feet or 169 square feet which is 2,028 for all twelve sides. The concrete volume of the two channel sides is ½ of 19 feet by 26 feet by 3 feet thick or 741 cubic feet for one and 2964 cubic feet for all four. Since only three inches is above the water table it can all be considered below the water table. The Common splitter has the same dimensions but with a 7 foot thickness equaling a concrete volume of 1,729 cubic feet which is subtracted from the void space below the water table.

The back wall of each service pump area is 25’ 4” wide and from the 588 from elevation to approximately the 555’ 6” elevation or 823.33 square feet for each tunnel area resulting in 4,940 square feet for all 6 channel areas. The volume of the back walls is 25’ 4” by 32’ 6” by 4‘ thick or 329.33 cubic feet per channel resulting in 19,760 cubic feet for all 7 channels. The amount below the water table is 23.5 by 25.33 by 4 feet for 6 channels or 14,288 cubic feet. The outer wall concrete volumes were included in the volume calculated for the shell.

The Circulating water intake tunnels extend from the 537’ to the 549’ 6” or 12’ 6”. As seen in Figure 27, there is a slanted portion with 6’ 5” base and 14 height whose hypotenuse is 15.40 feet resulting in a surface area of 192.51 square feet per side or 2310.07 square feet for all 12. The floor and ceiling surface areas of the funnel area are 12’ 6” plus the 3’ 2.5” with a midpoint of the 6’ 5” or 15.71 feet by 14 feet each. This equals 219.92 feet per floor surface which is 2369 square feet for all 12 floors and walls. The walls are 2 feet thick with the centers filled with sand. The concrete volume of each wall is 15.4 feet by 12.5 feet by 2 feet or 385.01 cubic feet per wall which is 4620.13 cubic feet for all 12 walls. There are two triangle shaped sand filled areas for each unit that are 12’ 6” high, by 6’5”on a side wide by 14 feet. This results in a void space sand volume of 4,491.67 cubic feet for all four areas. The common area is 7’ 11” by 14 feet of sand or 1385.42 cubic feet. The additional concrete on the outer walls is 6’ 5” by 14 by 12’6” or 1,129.55 cubic feet.

There is also a rectangular portion of each intake tunnel which is where the pump veins are. There are two side walls that are 15’ 3” long by 12’ 6” high which is 190.63 square feet per wall or 2287.5 for all 12. The side walls are also 2 feet thick with rest of the volume being filled with sand. The side walls are 381.25 cubic feet each or 4575 cubic feet for all 12. The back walls are 2 feet thick on the interior surface of the cubicles as shown on B-56 Section TT. They have sump areas on the back side that range in bottom elevations from 556 to 532 bottom floor elevations. The interior walls of the circ water pump intake tunnels are 12’6” by 12’ 6” or 156.25 square feet or 937.5 square feet for all 6. At two feet thick this equals 1875 cubic feet of concrete for all 6.

The floors are 12’6” by 15’ 3” or 1143.75 square feet for all 6. The concrete volume has already been calculated as part of the floor slab. The ceiling is a slab with 6 holes for the Circ Water Pumps that average 8’ 6” in diameter the bottom of the cone has an approximate radius of 7’3”. Each ceiling surface area is 12’6 by 15’ 3” minus the 7’ 3” radius of the opening or 25.5 square feet per ceiling which is 152.97 square feet for all 6 ceilings.

The concrete floor of the tunnels run under is 171 feet wide by 29.25 feet wide with 6 circulating water pump shaft openings with an average radius of 4’ 3”. The slab is 558’ minus 549’ 6” or 8.5

feet thick. This is 39,634.48 cubic feet when the cone shaped opening volume of the 6 pumps is subtracted.

As seen in B-44 and Figure 26, each sump area has a 3’ by 3’ hatch. There are 7 sump areas in all when the one behind the common splitter is included. The 552’ elevation floor is 11’3” wide by 171 feet long equaling 1860.75 square feet when the hatches are subtracted. The surface area on the drop from the 558 elevation to the 552’ 3” elevation is 171 by 5.25 feet or 920.25 square feet.

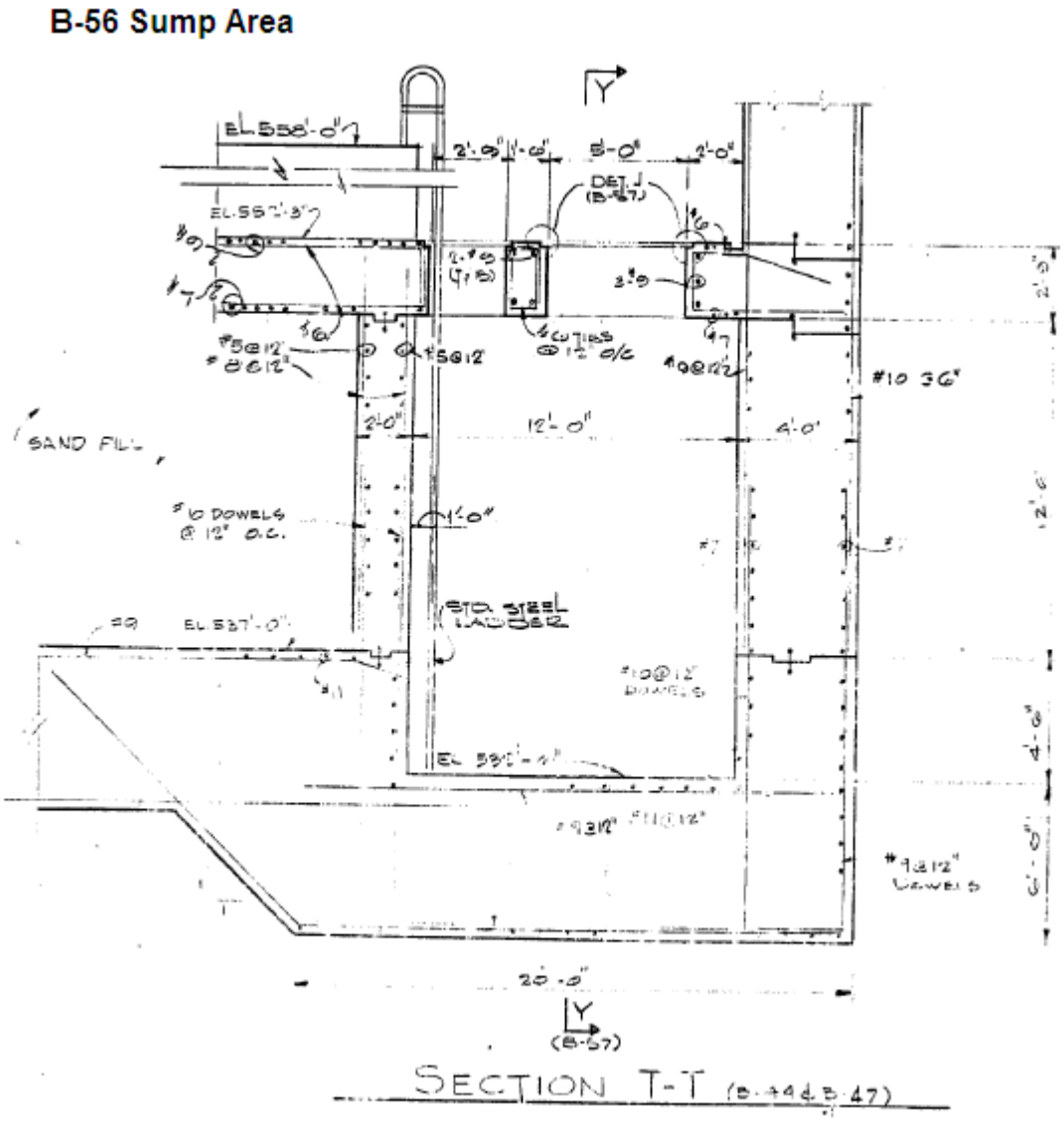


Figure 28 - 532' 6" Sump Behind Common Intake Splitter

The 552’ 3” elevation floor slab is 2 feet thick by 171 feet long by 11’3” wide with 7 3’ by 3’ hatch openings or 3271.5 cubic feet.

Six of the sump areas are approximately at elevation 636’5” with one at 632’ 6”. The six sumps areas are 12’ by 12’6” inside minus the 3 foot by 3 foot hatch opening for 141 square feet each or 846 square feet for all 6. The sump area floors are 12’ by 12’ 6” or 150 square feet each for 900

square feet for all 6. The average depth of the 6 sumps is 636' 5". The side walls are 13.88 feet deep. The surface area of each side wall is 12 feet by 13.88 feet or 166.6 square feet per wall or 1,666 square feet for the 10 side walls whose surface areas were not part of the hollowed out shells surface area down to the 537' elevation. The front walls and back walls are 13.88 feet high by 12'6" wide or 173.54 square feet each. This is 1,041.25 square feet for the 6 front walls. The back walls surface area was already included in the calculation of the hollowed out shells surface area. The 7" lower depth adds 12' by 12' 6" by 0.58' or 525 cubic feet for all 6 sumps. The added concrete volume consists of 8 interior walls, not counting the common sump walls 12' by 2 feet by 13.88 feet high or 333.2 cubic feet per interior wall or 2665.60 cubic feet for all 8. No credit will be taken for the extra 6.5 foot thickness on the side walls since it can't be verified on the drawings. The 532' 6" common sump ceiling area is 15' 10" by 12 feet minus the 3' by 3' hatch or 181 square feet. The floor is 15.8 by 12 feet or 190 square feet. The interior side walls are 17.75 feet by 12 feet or 213 square feet each or 426 square feet total. At two feet thick, this equals 426 cubic feet per wall or 852 cubic feet total. The additional void space below the water table is 958 cubic feet.

Void space volume taken up by 6 the rectangular sand filled areas is 21' 9 inches long by 11' 10" wide to the 537' elevation or 2445 square feet each with 9780.25 square feet for all four. The common area rectangular sand is 15.25 feet long by 15.83 wide by 9.50 feet deep or 2293.85 cubic feet.

As seen in Table 36 the interior concrete was 73,812.5 square feet in addition to the 7.47E+04 square feet in Table 35. This increased the estimated surface area to 148,518 square feet by a factor of 1.99.

Table 36 - Parameters and Calculated Surface Areas for Interior Walls and Floors

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Basket East Wall	23	171	3933	2	7866
Common Flow Splitter East of Stop Logs Sides	20	28	560	2	1120
Center Common Flow Splitter East of Stop Logs Top	20	7	140	1	140
Center Flow Splitter Sides	13	28	364	12	4368
Center Flow Splitter Top	13	3	39	6	234
Channel Flow Splitters Past Stop Logs	15.95	28	446.54	8	3572.33
Channel Flow Splitters Past Stop Logs	15.95	3	47.84	4	191.38
Common Flow Splitter West of Stop Logs Sides	36.5	51	1861.50	2	3723.00
Common Flow Splitter West of Stop Logs Top	36.5	7	255.50	1	255.50
Channel Flow Splitters Past West of Stop Logs Sides	36.5	51	1861.50	8	14892
Channel Flow Splitters Past West of Stop Logs Tops	36.5	3	109.50	4	438
Slanted Wall					
Traveling Screen Slanted	29.97	25.33	759.16	12	9109.9
Traveling Screen Straight	8.75	25.33	221.67	12	2660
Service Water Opening	8.23	6	-49.38	12	-592.56

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Service Pump Sides Rectangle	13	8.75	113.75	12	1365
Service Pump Sides Triangle	13	26	169	12	2028
Service Pump Back Walls	32.5	25.33	823.33	6	4940
Circ Pump Intake Tunnel Slanted Walls	12.5	15.40	192.51	12	2310.07
Circ Pump Intake Funnel Floors and Ceilings	15.71	14.00	219.92	12	2639
Circ Pump Intake Side Walls	12.50	15.25	190.63	12	2287.5
Back Wall Circ Water Pump Intake Tunnels	12.5	12.50	156.25	6	937.5
Floor Circ Water Pump Intake Tunnels	15.25	12.50	190.63	6	1143.75
Intake Tunnel Ceiling	15.25	12.50	25.50	6	152.97
552 Foot Elevation Floor	11.25	171.00	1860.75	1	1860.75
Wall 558 to 552 3"	5.75	171.00	920.25	1	920.25
Sump Area Ceilings	12.5	12.00	141.00	6	846
Sump Area Floors	12.5	12.00	150.00	6	900
Sump Side Walls	13.88	12	166.6	10	1666
Front and Back Sump Walls	13.88	12.5	173.54	6	1041.25
Common Sump Area Ceiling	15.8	12.00	181	1	181
Common Sump Area Floor	15.8	12.00	190	1	190
Common Sump Area Side Walls	17.75	12	213	2	426
Totals					**73812.5**
Crib House Totals					121779.55
Overall Total					**148518**
Increase					1.99

As seen in Table 37 the interior concrete increased the estimated concrete volume by a factor of 1.46.

Table 37 - Interior Concrete Parameters and Calculated Volumes

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Basket East Wall	23.00	171.00	2.00	7866.00	1	7866.00
Center Common Flow Splitter East of Stop Logs	20	7	28	3920.00	1	3920.00
Center Flow Splitter	13	28	3	1092.00	6	6552.00
Channel Flow Splitters Past Stop Logs	15.95	28	3	1339.63	4	5358.50
Common Flow Splitter West of Stop Logs	36.5	51	7	13030.50	1	13030.5
Channel Flow Splitters Past West of Stop Logs	36.5	51	3	5584.50	4	22338

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Channel Tunnel Sloped and Straight Traveling Screen Wall	38.72	25.33	2	1862.88	6	11177.30103
Service Side Wall for Tunnel Splitters Rectangular	19.00	8.75	3	840.00	4	3360.00
Common Splitter Wall Rectangular of Service Pump Sides	19.00	8.75	7	2346.75	1	2346.75
Service Side Wall for Tunnel Splitters Triangular	19.00	26	3	741.00	4	2964.00
Common Splitter Wall Triangular of Service Pump Sides	19.00	26	7	1729.00	1	1729.00
Back Service Pump Area Concrete Volume	32.50	25.33	4	3293.33	6	19760.00
Triangle Sand Filled Areas	14.00	12.50	6.42	1122.92	4	4491.67
Outer Fan Shaped Walls Additional Concrete	6.45	14	12.5	1129.55	1	1129.55
Circ Pump Intake Side Walls	12.50	15.25	2	381.25	12	4575.00
Back Wall Circ Water Pump Intake Tunnels	12.5	12.50	2	312.50	6	1875.00
Ceiling Slab over Cir Pump Intake Tunnel	29.25	8.5	171	39634.48	1	39634.48
552' 3" Floor Slab over Sumps	11.25	171	2	3721.50	1	3721.50
Interior Sump Walls	12.00	13.88	2.00	333.20	8	2665.60
Common Sump Area Side Walls	17.75	12	2.00	426.00	2	852.00
Totals						159346.85
Crib House Totals						403081.51
Overall Total						505025.66
Increase						1.46

The void space below the water table decreased by a factor of 0.86 due to the concrete and sand volume below the water table shown in Table 38.

Table 38 - Parameters and Calculated Values of Void Space Volume below the Water Table with Interior Structures In Place

Item	Length ft	Width ft	Height to Water Table ft	Total Volume per Item ft^3	Total Volume per Item m^3
Basket East Wall	-171.00	2.00	14.00	-4788.00	-135.58
Center Common Flow Splitter East of Stop Logs	-20	7	28	-3920.00	-111.00
Center Flow Splitters (6)	13	28	3	-6552.00	-185.53
Channel Flow Splitters Past Stop Logs	15.95	28	3	-5358.5	-151.74
Common Flow Splitter West of Stop Logs	36.5	7	42	-10731	-303.87
Channel Flow Splitters Past West of Stop Logs	36.5	3	42	-18648	-528.05

Item	Length ft	Width ft	Height to Water Table ft	Total Volume per Item ft^3	Total Volume per Item m^3
Channel Tunnel Sloped and Straight Traveling Screen Wall	25.33	2	29.72	-9626.42	-272.59
Service Side Wall for Tunnel Splitters Triangular	19.00	3	26	-2964	-83.93
Common Splitter Wall Triangular of Service Pump Sides	19.00	7	26	-1729	-48.96
Back Service Pump Area Concrete Volume	25.33	4	23.5	-14288	-404.59
Funnel shaped Walls	14.00	12.50	6.42	-4491.67	-127.19
Triangle Sand Filled Areas	6.42	14	12.5	-4491.67	-127.19
Common Triangle Sand Filled Area	7.92	14	12.5	-1385.42	-39.23
Outer Fan Shaped Walls Additional Concrete	6.45	14	12.5	-1129.55	-31.99
Circ Pump Intake Side Walls	15.25	2	12.50	-4575	-129.55
Back Wall Circ Water Pump Intake Tunnels	12.50	2.00	12.50	-1875	-53.09
Ceiling Slab over Cir Pump Intake Tunnel	29.25	8.5	171	-39634.48	-1122.32
552' 3" Floor Slab over Sumps	11.25	171	2	-3973.50	-112.52
Sump Additional Void Space	12.00	12.50	0.58	525.00	14.87
Interior Sump Walls	12.00	13.88	2.00	-2665.60	-75.48
Common Sump Area Side Walls	17.75	12.00	2.00	-852.00	-24.13
Common Sump Area Additional Void Space	17.75	12.00	4.50	958.50	27.14
Rectangular sand areas	21.75	11.83	9.50	-9780.25	-276.95
Common Area Rectangular Sand	15.25	15.83	9.50	-2293.85	-64.95
Totals				**-154269.40**	**-4368.42**
Crib House Totals				845311.10	23936.54
Overall Total				**923737.897**	**26157.344**
Ratio				**0.86**	**0.86**

3.3. Waste Water Treatment Facility (WWTF)

The Waste Water Treatment Facility (WWTF) end state consists of concrete settling and equalization tanks, clarifiers and floculant (floc) and sludge tanks with sloped bottoms as seen in the top view of the WWTF basement in Figure 29. Most of the end state concrete below the 588' elevation is above the 579' water table. The floors of the structures will be perforated to ensure they can equilibrate with the water table and will not overflow the structure at the 588' elevation.

Table 39 - WWTF Northwest Area Surface Area

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Electrical Area Floor	23.5	11	258.5	1	258.5
Electrical Area E&W Walls	23.50	0.5	11.75	2	23.5
Electrical Area N&S Walls	11.00	0.5	5.50	2	11.0
Filter Area Floor	34	26	884.00	4	3536.0
Filter Area Sump N&S Walls	3.00	4.75	14.25	2	28.5
Filter Area Sump E&W Walls	5.00	4.75	23.75	2	47.5
Filter Area N&S Walls	34.00	10	340.00	2	680
Filter Area E&W Walls	26.00	10	260.00	2	520
		Totals	**1797.75**		**5105**

The Electrical Room floor is 23’6” by 11’ and is at the 587’6” level such that it is above the water table and only six inches below the 588’ end state. The Filter Tank area is 34’ by 26’ and is located at the 578’ elevation; it has a 3’ by 5’ sump at the 573’4” elevation. This results in the surface areas shown in Table 39.

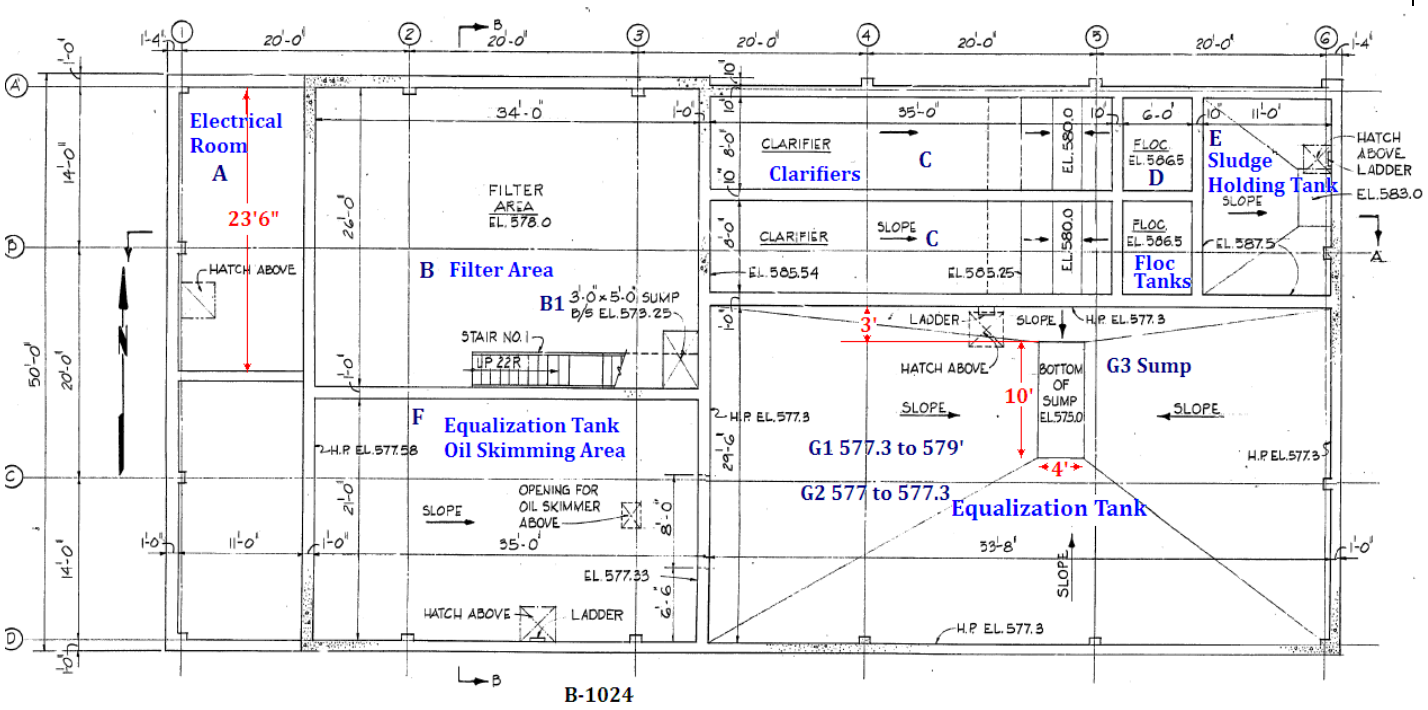


Figure 29 - Waste Water Treatment Facility Top View from Drawing B-1024

As seen in Figure 30 the Filter Area 34’ by 26’ floor is slightly below the 579’ water table at the 578’ elevation. The 3’ by 5’ sump floor is 5.75’ below the main floor at 573’3”.

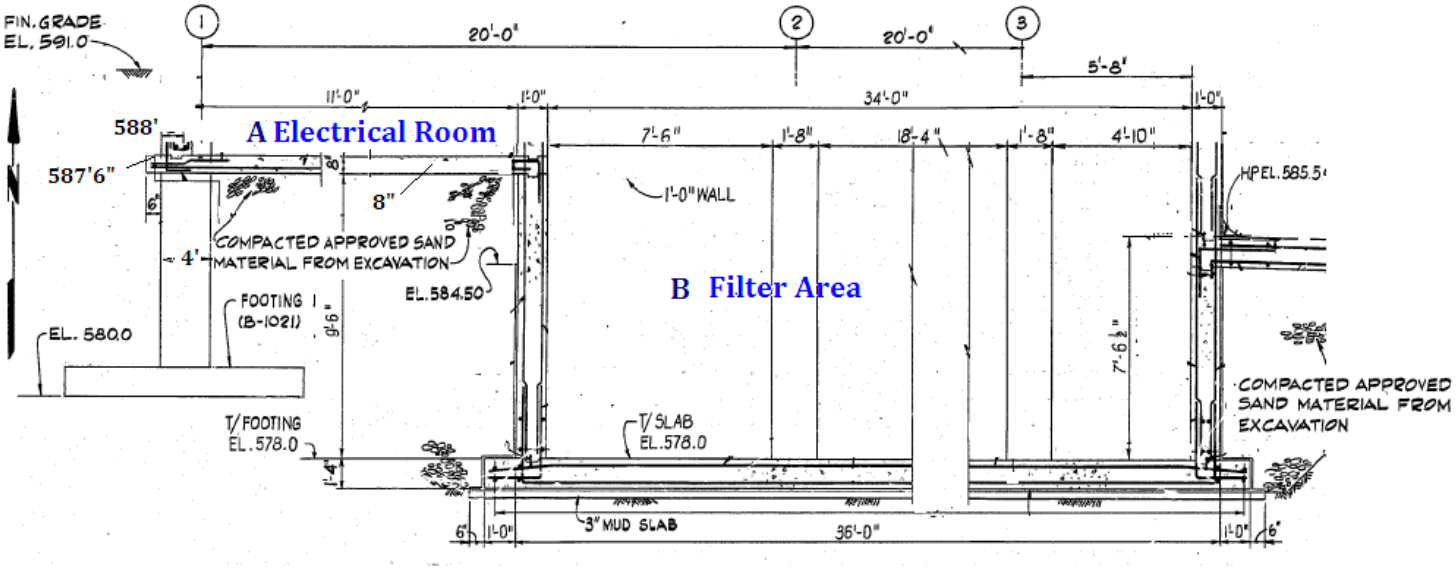


Figure 30 - Side View Northwest WWTF from B-1019

This results in a void space below the water table of 2,723 cubic feet as seen in Table 40.

Table 40 - WWTF Northwest Area Void Space Below 579' Water Table

Item	Length ft	Width ft	Height to Water Table ft	Total Volume per Item ft^3
Filter Area Floor	34.00	26.00	1.00	884.00
Filter Area Sump	3.00	5.00	5.75	86.25
			Totals	**970**

The Electrical Room floor is 8 inches thick as seen in Figure 30 with one foot thick walls as seen in Figure 29. The East wall concrete volume of the Electrical Room is included as part of the Filter Area concrete volume. The Filter Area floor is 1'4" thick. The walls are 1' thick as seen in Figure 29 and Figure 30. The concrete volumes of the Electrical Room and Filter Area are shown in Table 38.

Table 41 - Concrete Volumes for WWTF Electrical Room and Filter Area End States

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Electrical Area Floor	23.5	11	0.67	172.33	1	172.33
Electrical Area N&S Walls	11.0	0.5	1	5.50	2	11.00
Electrical Area West Wall	23.5	0.5	1	11.75	1	11.75
Filter Area Floor	34	26	1.33	1178.67	1	1178.67
Filter Area Sump N&S Walls	3.00	4.75	1.00	14.25	2	28.50
Filter Area Sump E&W Walls	5.00	4.75	1.00	23.75	2	47.50
Filter Area N&S Walls	34.00	10	1.00	340.00	2	680.00
Filter Area E&W Walls	26.00	10	1.00	260.00	2	520.00
			Totals	**2006.25**		**2649.75**

As seen in Figure 29 and Figure 31 the northeast portion of the WWTF contains two (north and south) Clarifiers and Floculant Tanks and a single Sludge Holding Tank. Each Clarifier consists of a mildly sloped floor that drops from the 585.54' elevation to 585.25' elevation after 27.5' (30'-2'-2.5'-3') and is 8 wide. There is then a pit with angled east and west walls and a 2'6" wide floor. A 6" opening in the East wall above the pit allows flow to the Floculant Tank. The sloped floor length is the square root of the 27.5 feet squared plus the 0.29' drop squared or 27.502 feet resulting in a floor surface area of 220.01 square feet per clarifier. The surface area of the west wall of each clarifier is the 8' width by the 588' minus 585.54' height or 2.46 feet which equals 19.68 square feet per clarifier. The surface area of the north and south walls above the sloped floor are the 27'6" lengths by the average depth of 2.605 feet or 71.64 square feet per wall. The north and south walls above the Clarifier Pits are 7'6" long with a 2.75' depth below the 588' elevation equaling 20.63 square feet per wall.

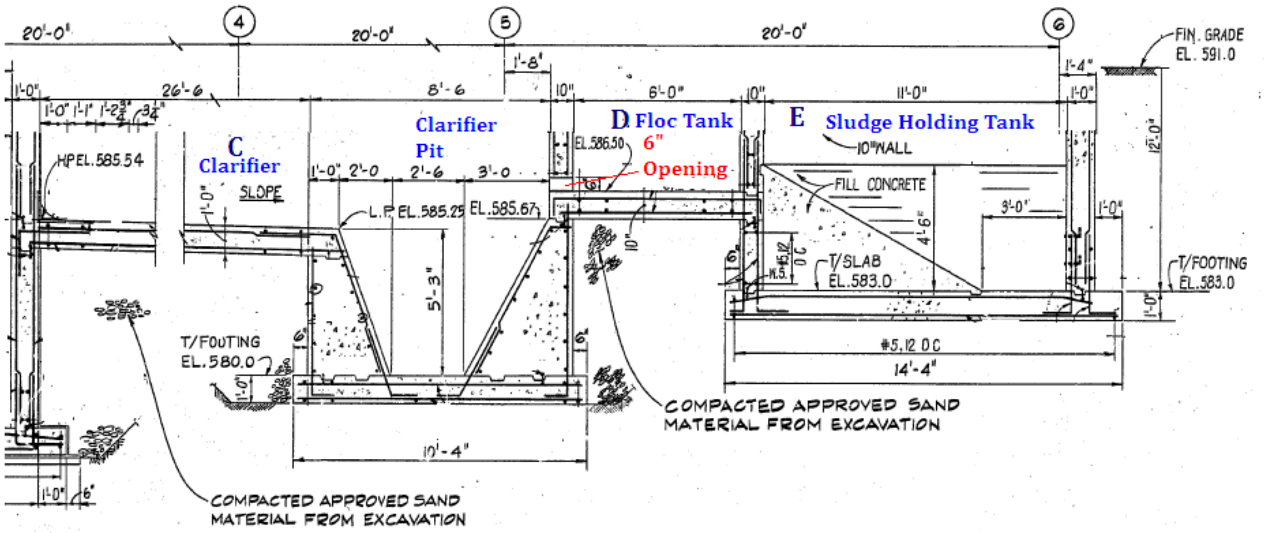


Figure 31 - Side View Northeast WWTF from B-1019

The East wall of the clarifier pit has a depth of the 588' elevation to 585.67' elevation with a 6" opening for a depth of 1.83 feet, with an 8 foot width this equals 14.64 square feet. The west face of each Clarifier Pit slopes with a length equaling the square root of 2' squared plus 5.25' squared or 5.62 feet long. At an 8' width this equals 44.94 square feet each. The east wall slopes from the 585.67' elevation to the 580' elevation pit bottom. The length is the square root of 3' squared plus 5.67' squared 6.41 feet resulting in a surface area 51.32 square feet each. The Clarifier Pit floor is 2.5 by 8 feet or 20 square feet. The east and west walls of the pit are made up of two triangles and a rectangles as seen in Figure 31. The average width of the pit is 1' plus 2.5' plus 1.5' or 5 feet. The depth is 5.25 feet resulting in a surface area of 26.25 feet per wall. There is an additional surface area created by the 6" opening to the Floc Tank. The top and bottom are 10" by 8' and the sides are 6" by 10". The north and south Clarifier Surface areas are summarized in Table 42.

Table 42 - East and West Clarifier Surface Areas

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Clarifier 585' Floor	27.502	8	220.01	2	440.02
Clarifier W Wall	8	2.46	19.68	2	39.36
Clarifier N & S Wall Above Floor	27.50	2.605	71.64	4	286.55
Clarifier N & S Wall Above Pit	7.50	2.75	20.63	4	82.5
Clarifier E Wall	8	1.83	14.64	2	29.28
Clarifier Pit West Face	5.62	8	44.94	2	89.9
Clarifier Pit East Face	6.41	8	51.32	2	102.6
Clarifier Pit Floor	2.50	8	20.00	2	40.0
Clarifier Pit N&S Walls	5.00	5.25	26.25	4	105
Top and Bottom Floc Tank Opening	0.83	8	6.67	2	13.3
Sides Floc Tank Opening	0.50	0.833	0.42	2	0.8
		Totals	**496.19**		**1229.41**

Since the lowest Clarifier elevation is the 580' elevation of the pit, there is no void space below the 579' water table. The concrete volume of the south wall of the south Clarifier is included in the Equalization Tank concrete volume, resulting in a two 8 foot wide floors and three 10" wide wall thicknesses since the north wall has an additional 10" outer layer making it 20" thick. This results in 18'6" width across both Clarifiers. The concrete volume under the sloped floor is 27.502 feet long by 18.5 feet wide and 1' thick or 508.78 cubic feet. The calculated Clarifier concrete volumes are provided in Table 43.

Table 43 - North and South Clarifier End State Concrete Volumes

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Clarifier 585' Floor	27.50	18.50	1	508.78	1	508.78
Clarifier W Wall	18.50	2.46	1	45.51	1	45.51

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Clarifier N & S Wall Above Floor	27.50	2.605	0.83	59.70	3	179.09
Clarifier N & S Wall Above Pit	7.50	2.75	0.83	17.19	3	51.56
Clarifier E Wall	18.50	1.83	0.83	28.21	1	28.21
Clarifier Pit West Face	5.25	18.50	2	194.25	1	194.25
Clarifier Pit East Face	5.67	18.50	2.33	244.76	1	244.756
Clarifier Pit Floor	2.50	18.50	1	46.25	1	46.25
Clarifier Pit N&S Walls	5.00	5.25	0.83	21.88	2	43.75
			Totals	**1166.52**		**1342.16**

The volumes of the walls above the pit are as described in the surface area calculation with a 1 foot thickness for the West wall and 20" thicknesses for the north wall, and 10 " thickness for the south and east walls. As seen in Figure 31, the west wall of the Clarifier Pit has an average width of 2' with a depth of 5'3" and this concrete spans the 18.5' width for a volume of 194.25 cubic feet. Similarly the East wall of the pit has an average width of 1'6" plus 10" or 2.33 feet with a depth of 5.67' which with a 18.5' width equals 244.76 cubic feet. Between the walls, the pit floor is 2.5 feet long by 18.5' wide and 1' thick. The north and south walls of the clarifier are 10" thick the north wall has an additional 10" thick outer layer as seen in Figure 29.

The north and south Floc Tanks are 6 feet long by 8 feet wide and 1'6" deep. The west wall has a 6" opening and is only 1 feet deep. The Floc Tank Surface Areas are shown in Table 44.

Table 44 - North and South Floc Tank Surface Areas

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Floc Tank Floor	6.00	8	48.00	2	96.00
Floc Tank W Wall	8	1	8.00	2	16
Floc Tank E Wall	8	1.5	12.00	2	24
Floc tank N & S Wall	6.00	1.5	9.00	4	36
		Totals	**77.00**		**172.00**

Since the Floc tank bottoms are at the 586'6" elevation there is no void space below the 579' water table. As with the clarifiers the southernmost wall concrete volume is calculated as part of the Equalization Tank concrete volume. The length of the 10" floor slab that is not included in the wall volumes is 6'10". The Floc Tank west wall volume was included in the Clarifier volume. The east wall volume is calculated as part of the Sludge Holding Tank volume. The Floc Tank north and south walls are 10" thick and 6' long by 1'6" deep. The outer wall of the north wall includes an additional 10" thick portion.

Table 45 - WWTF North and South Floc Tank End State Concrete Volumes

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Floc Tank Floor	6.83	18.5	0.83	105.35	1	105.35
Floc tank N & S Wall	6.00	1.5	0.83	7.50	3	22.50
			Totals	**112.85**		**127.85**

The Sludge Holding Tank walls slope from the 587.5; to 583' as seen in Figure 29and Figure 31. The tank interior is 11' by 16'10". The floor is 3' by 5' as seen on drawing B-1018. The west wall has a top width of 16'10" and a bottom width of 5' for an average width of 16'10" minus 5 feet equals 11'10" half of which is 5'11" thus the average width is 5' of the sump plus 5'11" on either side of it or 10'11". The top of the sloped walls are 4'6" above the 583' floor at the 587'6" elevation and the wall extends 9' to the sump floor. The length of the wall is the square root of 4.5 feet squared plus 9 feet squared or 9.18 feet. The surface area of the Sludge Holding Tank west wall is 100.2 square feet. The East wall also has an average width of 10'11" but is vertical with a height of 4'6" for a surface area of 49.13 inches. The East and West walls are 11' at the top and 3' at the bottom for an average width of 7'. The length of each wall is the square root of 5'11" squared plus 4'6" squared or 7.43 feet. There is also a 6" band below the 588' that is above the top of sloped walls at 587'6".

Table 46 - WWTF Sludge Holding Tank End State Surface Areas

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Sludge Holding Tank Floor	3.00	5	15.00	1	15
West Wall	9.18	10.92	100.20	1	100.20
East Wall	4.5	10.92	49.13	1	49.13
North and South Walls	7.43	7.00	52.03	2	104.07
East and West Walls Above 587'6"	0.5	16.83	8.42	2	16.83
North and South Walls Above 587'6"	0.5	11.00	5.50	2	11.00
		Totals	**230.28**		**296.23**

There is no void space below the water table associated with the sludge holding tank. The floor slab is 1' thick and has a length that is the west wall thickness of 10" plus 11' plus the east wall 1'4" thickness or 13.17' long. The slab width is the 16'10"tank interior plus the 20" thick north wall or 18.5'. The west wall has an 8' length at the base, thus the average width across the 4'6" height is 4 feet with an additional 10" for the west wall making the length 4'10". The average interior width is 10'11" as described above plus the additional 20" thickness of the north wall portion or 12.58'. With a 4'6" height this equals a concrete volume of 273.69 cubic feet. The wall has an 11' top and a 3' bottom for an average length of 7 feet plus the 1' thick east wall equals 8'. The height is 4'6" and the width is the 20" north wall thickness plus half the 5'11"base or an average width of 4.63 feet. The sloped south wall is the same as the north except that the 1' thick portion of the south wall is

part of the Equalization Tank volume so the average width is half the 5'11" base or 2.96'. The east wall has the same average length as the west wall at 12.58' with a 4'6" height and 1' thickness. There are also the remaining 6" portions of the walls above the 587'6" top of the sloped walls. The end state concrete volumes for the WWTF Sludge Holding Tank are provided in Table 47.

Table 47 - WWTF Sludge Holding Tank End State Concrete Volumes

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Sludge Holding Tank Floor	13.17	18.50	1.00	243.58	1	243.58
Sloped West Wall	4.50	12.58	4.83	273.69	1	273.69
Sloped North Wall	4.50	8.00	4.63	166.50	1	166.50
Sloped South Wall	4.50	8.00	2.96	106.50	1	106.50
East Wall	4.50	12.58	1.00	56.63	1	56.63
East and West Walls Above 587'6"	18.50	0.50	1.00	9.25	2	18.50
North Wall Above 587'6"	11.00	0.50	1.67	9.17	1	9.17
			Totals	**865.31**		**874.56**

As seen in Figure 29, the southern half of the WWTF consists of the Equalization Tank Oil Skimming Area and the Equalization Tank. As seen in Figure 32, only western portion of the slab is above the 588' end state. The Oil Skimming Area is 21' wide by 34' long and slopes from the 577.58' elevation on the west end to the 577.33' elevation on the east end. This is a 3" drop in elevation. The length of the floor area is the square root of 34' squared plus 0.25' squared or 34.001 feet. The average height of the north and south walls of the oil skimming area are 588' minus 577.455' (e.g. 577.33' plus 0.125') or 10.66'.

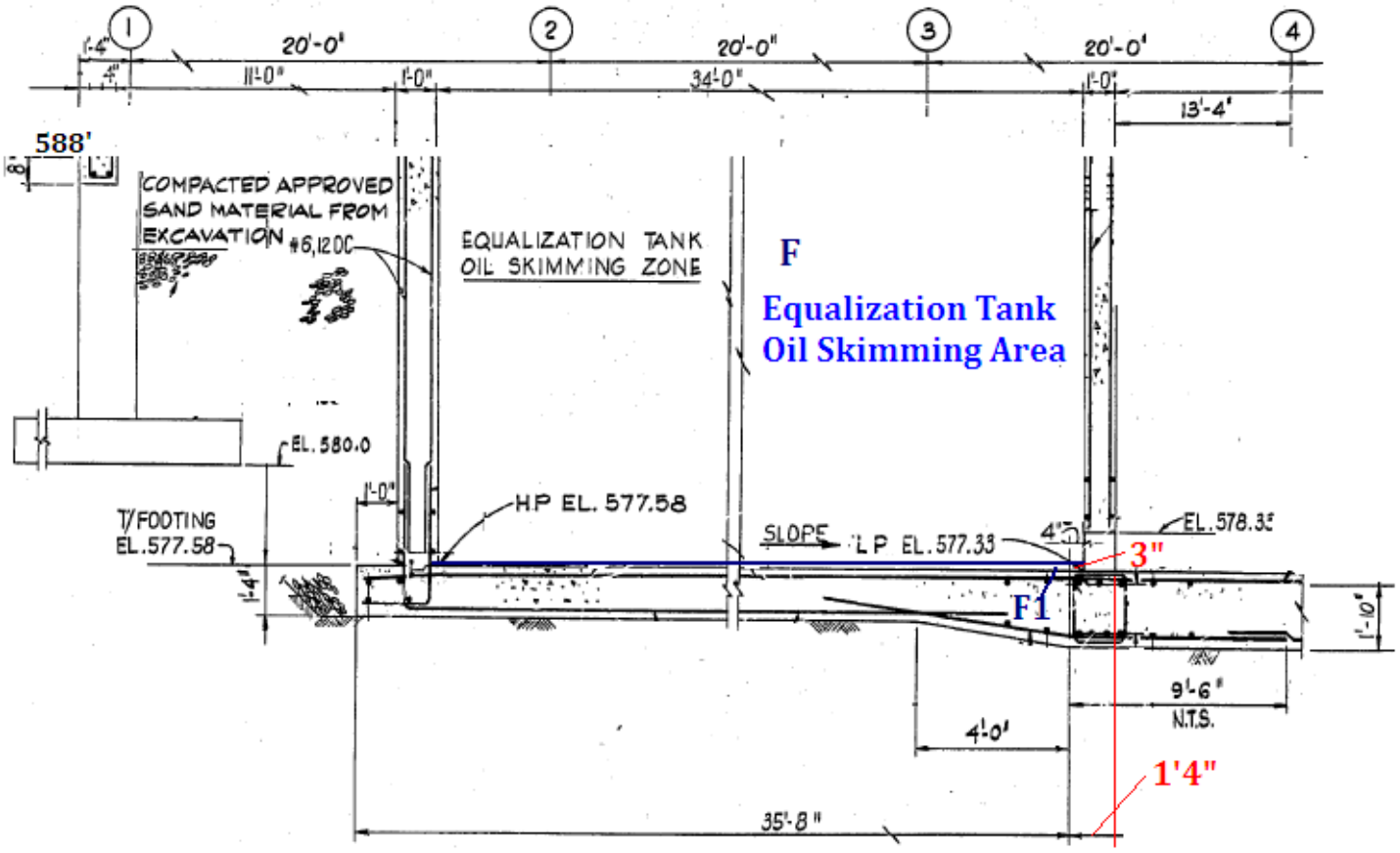


Figure 32- Side View Southwest WWTF End State from B-1019

The west wall is 21' wide by 10.42' high and the south wall is 21' wide by 10.67 feet high. The Equalization Tank Oil Skimming Area end state surface areas are provided in Table 48.

Table 48 - WWTF Equalization Tank Oil Skimming Area End State Surface Areas

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Oil Skimming Area Floor	34	21	714.02	1	714.02
Oil Skimming Area North and South Walls	34	10.66	362.35	2	724.71
Oil Skimming Area West Wall	21	10.42	218.82	1	218.82
Oil Skimming Area East Wall	21	10.67	224.07	1	224.07
		Totals	**1519.26**		**1881.62**

The bottom of the area is slightly below the 579' water table with an average bottom depth of 577.455'. The average depth 1.54' below the water table results in a 1,103.13 cubic foot void space as seen in Table 49

Table 49 - WWTF Equalization Tank Oil Skimming Area End State Void Space Below 579' Water Table

Item	Length ft	Width ft	Height to Water Table ft	Total Volume per Item ft^3
Equalization Tank Oil Skimming Area	34.00	21.00	1.54	1103.13

The floor slab is 1'4" thick for most of the length, but transitions to 1'10" thick starting at 4' west of the east wall. The slab extend 1' past the 1' thick west wall making it 36' long. The north and south walls are 1' thick making the slab 23' wide. The average increase in thickness across the 4 feet at which the slab transitions from 1'4" to 1'10" is 3 inches. The transition concrete volume to the east wall is 4' by 23' by 0.25' or 23 cubic feet.

Table 50 - WWTF Equalization Tank Oil Skimming Area End State Concrete Volumes

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Sludge Holding Tank Floor	36.00	23.00	1.33	1104.00	1	1104.00
Sludge Holding Tank Floor Transition	4	23.00	0.25	23.00	1	23.00
Oil Skimming Area North and South Walls	34.00	10.66	1	362.35	2	724.71
Oil Skimming Area West Wall	21	10.42	1	218.82	1	218.82
Oil Skimming Area East Wall	21.00	10.67	1	224.07	1	224.07
			Totals	**1932.25**		**2294.60**

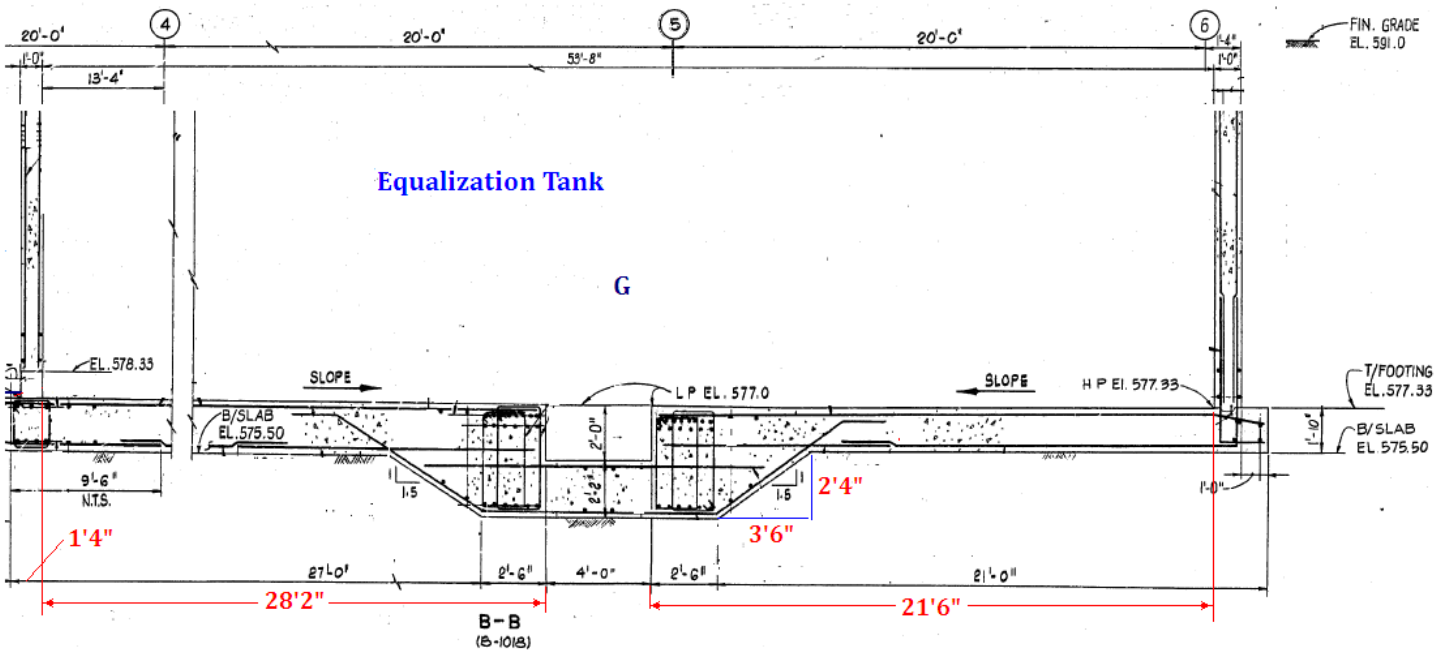


Figure 33 - WWTF Equalization Tank End State Side View from B-1019

As seen in Figure 29 and Figure 33 the Equalization Tank floor slopes from 577.3’ to the top of a 10’ by 4’ sump at 577’. The sloped floors can be broken up into geometries as shown in Figure 34.

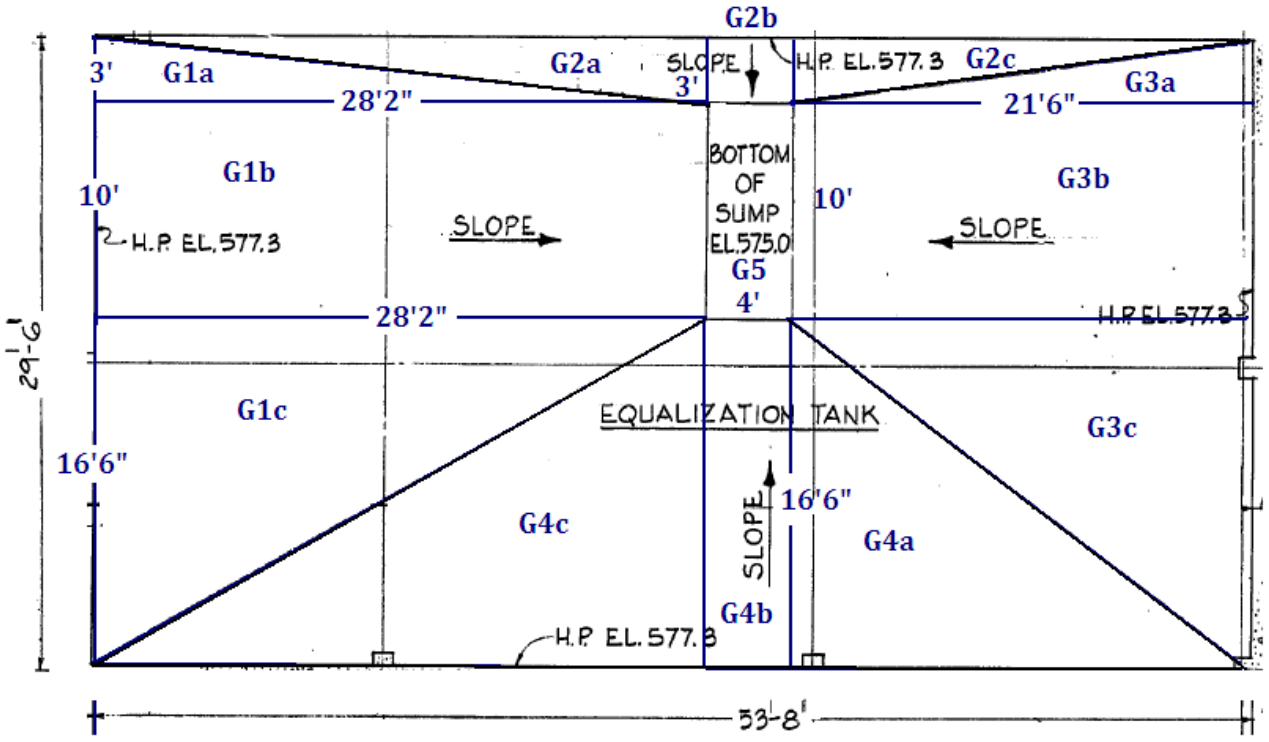


Figure 34 - Sloped Floor Geometries for Calculation of Surface Areas

For G1a the surface area is equal to a rectangle with a width of 1.5 feet or half the 3 foot width. The length corrected for the equals the square root of the 0.3 inch slope is the square root of 28’2” square plus 0.3 feet squared or 2.817 feet. Using this methodology the surface of the Equalization Tank below the 588 foot was calculated as seen in Table 51.

Table 51 - Equalization Tank Surface Areas Below 588 Foot Elevation

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
G1a Equalization Tank W Sloped Floor	28.17	1.5	42.25	1	42.25
G1b Equalization Tank W Sloped Floor	28.17	10	281.68	1	281.68
G1c Equalization Tank W Sloped Floor	28.17	8.25	232.39	1	232.39
G2a Equalization Tank N Sloped Floor	28.17	1.5	42.46	1	42.46
G2b Equalization Tank N Sloped Floor	3.01	4	12.06	1	12.06
G2c Equalization Tank N Sloped Floor	3.01	10.75	32.41	1	32.41
G3a Equalization Tank E Sloped Floor	21.50	1.5	32.25	1	32.25
G3b Equalization Tank E Sloped Floor	21.50	10	215.02	1	215.02
G3c Equalization Tank E Sloped Floor	21.50	8.25	177.39	1	177.39
G4a Equalization Tank S Sloped Floor	16.50	10.75	177.40	1	177.40
G4b Equalization Tank S Sloped Floor	16.50	4	66.01	1	66.01
G4c Equalization Tank S Sloped Floor	16.50	14.08	232.41	1	232.41
G5 Equalization Tank Sump Floor	4.00	10	40.00	1	40.00
Sump N&S Walls	4.00	2	8.00	2	16.00
Sump E&W Walls	10.00	2	20.00	2	40.00
Equalization Tank N&S Walls	53.67	10.7	574.23	2	1148.47
Equalization Tank E&W Walls	29.50	10.7	315.65	2	631.30
		Totals	**2501.63**		**3419.52**

The void space below the water table can be calculated by breaking the Equalization Tank into 3 parts. The rectangular volume from the top of the sloped floors at 577.3 ft to the water table at 579 foot elevation. The volume from the top of the sloped floor at 577.3 ft to the top of the sump at 577 ft. This is the same as the volume of a rectangular volume source with a height of 0.15 feet. The void space of the sump from the 575 foot bottom elevation to the 577foot elevation, as seen in Table 52.

Table 52 - Equalization Tank Void Space to Water Table

Item	Length ft	Width ft	Height to Water Table ft	Total Volume per Item ft^3
Equalization Tank Above 577.3 ft EL	53.67	29.50	1.70	2691.38
Equalization Tank Sloped Floors	53.67	29.50	0.15	237.48
Equalization Tank Sump Void Space	10.00	4.00	2	80.00
			Totals	**3009**

As seen in Figure 33, the floor slab under the tank is 1 foot 10 inches (i.e., 1.83 ft) thick, except for the area surrounding and directly below the sump which is thicker. As seen in Figure 29 and Figure 33, the walls are 1 foot thick.

Table 53- Equalization Tank Concrete Volumes

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Equalization Tank Main Floor Slab Floor	55.67	31.50	1.83	3214.75	1	3214.75
Main Floor Slab Sump Void Space	-4	10.00	1.83	-73.33	1	-73.33
Sump Area Tapered E&W	2.33	3.50	10.00	81.67	1	81.67
Sump Area Tapered N&S	2.33	3.50	9.00	73.50	1	73.50
Sump Area Side E&W	2.33	2.50	10.00	58.33	2	116.67
Sump Area Ends N&S	2.33	2.50	9.00	52.50	2	105.00
Volume Directly Below Sump	4.00	10.00	2.17	86.67	1	86.67
Equalization Tank N&S Walls	53.67	10.7	1.00	574.23	2	1148.47
Equalization Tank E&W Walls	29.50	10.7	1.00	315.65	2	631.30
			Totals	**4383.97**		**5384.68**

The end state surface area, void space below the water table and concrete volumes for the WWTF are summarized in Table 54

Table 54 - Waste Water Treatment Facility (WWTF) Summary of Surface Areas, Water Table Void Space and Concrete Volumes

Item	Total Surface Area ft^2	Total Water Table Void Volume per Item ft^3	Total Concrete Volume per Item ft^3
WWTF NW Electrical and Filter Area	5105	970	2656
WWTF NE Clarifiers	1229	0	1342
WWTF NE Floc Tanks	172	0	128
WWTF NE Sludge Holding Tank	296	0	875
WWTF SW Oil Skimming Area	1882	1103	2295
WWTF SE Equalization Tank	3420	3009	5385
WWTF Totals	**1.21E+04**	**5.08E+03**	**1.27E+04**

The abstracted model for the WWTF assumes an overall elevation of 577' and a water table void space of 5082.24 cubic feet and a 47.35' by 53.67' length and width as seen in Figure 29.

Table 55 - Example of WWTF Abstracted Model Based on Water Table Void Space

Description	Floor Elev ft	Length ft	Width ft	Area ft^2	Height to Water Table ft	Void Space to WT ft^3
Waste Water Treatment Facility	577	47.35	53.67	2541.12	2	5082.24

3.4. Spent Fuel Pool and Transfer Canal

The Spent Fuel Pool and Transfer Canal are the only end state structures below the 588’ elevation in the Spent Fuel Building (SFB). The 3/16” stainless steel liner on the Transfer Canal and Spent Fuel Pool will be removed in the end state. The Transfer Canal is in communication with Units 1 and 2 Containments from the fuel transfer tubes at the 578’6” elevation as seen in Figure 35. The transfer chute between the canal and pool is at the 592’ elevation. Since everything above the 588’ elevation will be removed in the end state the Transfer Canal will be isolated from the Spent Fuel Pool unless the 6 foot thick wall between them is perforated.

As seen in Figure 35 and Figure 36, the Transfer Canal and Spent Fuel Pool floors are at the 576 foot elevation. The Spent fuel pool walls are 6 feet thick.

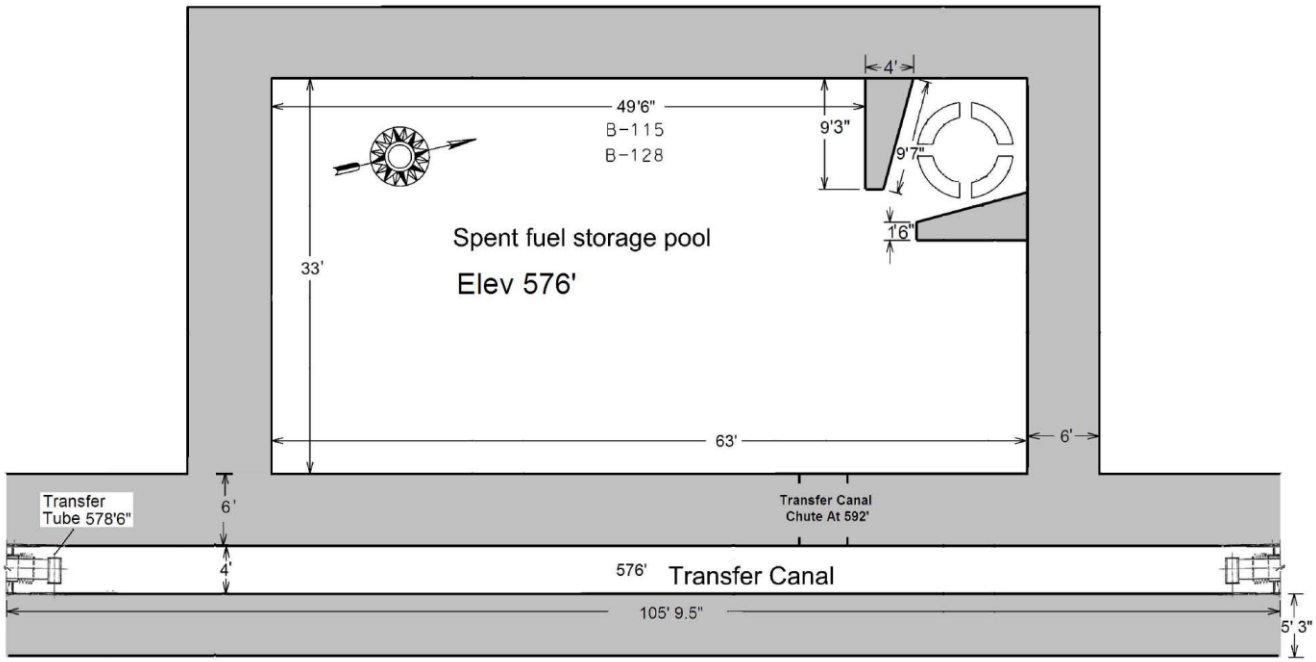


Figure 35 - Spent Fuel Pool and Transfer Canal Overhead View

The east wall of the Transfer Canal is 5’3” thick. The cask pit has two walls extending into the pool that are 9’3” long and tapers from 1’6” thick to 4’ thick. The surface areas for the walls and floors are shown in Table 56. The cask pit slanted walls lengths are 9.58 ft (the square root of 9.25 ft squared plus 2.5 ft squared) as seen in Figure 37.

Table 56 - Spent Fuel and Transfer Canal Surface Areas

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
West Wall	59	12	708	1	708
East Wall	63	12	756	1	756
South Wall	33	12	396	1	396
North Wall	29	12	348	1	348
Cask Pit Straight Wall	9.25	12	111	2	222
Cask Pit Ends	1.5	12	18	2	36
Cask Pit Slant	9.58	12	114.98	2	229.97
Pool Floor Covered by Cask Pit Walls	9.25	-5.5	-50.88	1	-50.88
Pool Floor	63	33	2079	1	2079
Transfer Canal East and West Walls	105.79	12	1269.5	2	2539
Transfer Canal North and South Walls	4	12	48	2	96
Transfer Canal Floor	4	105.79	423.17	1	423.17
		Totals	**6220.77**		**7782.26**

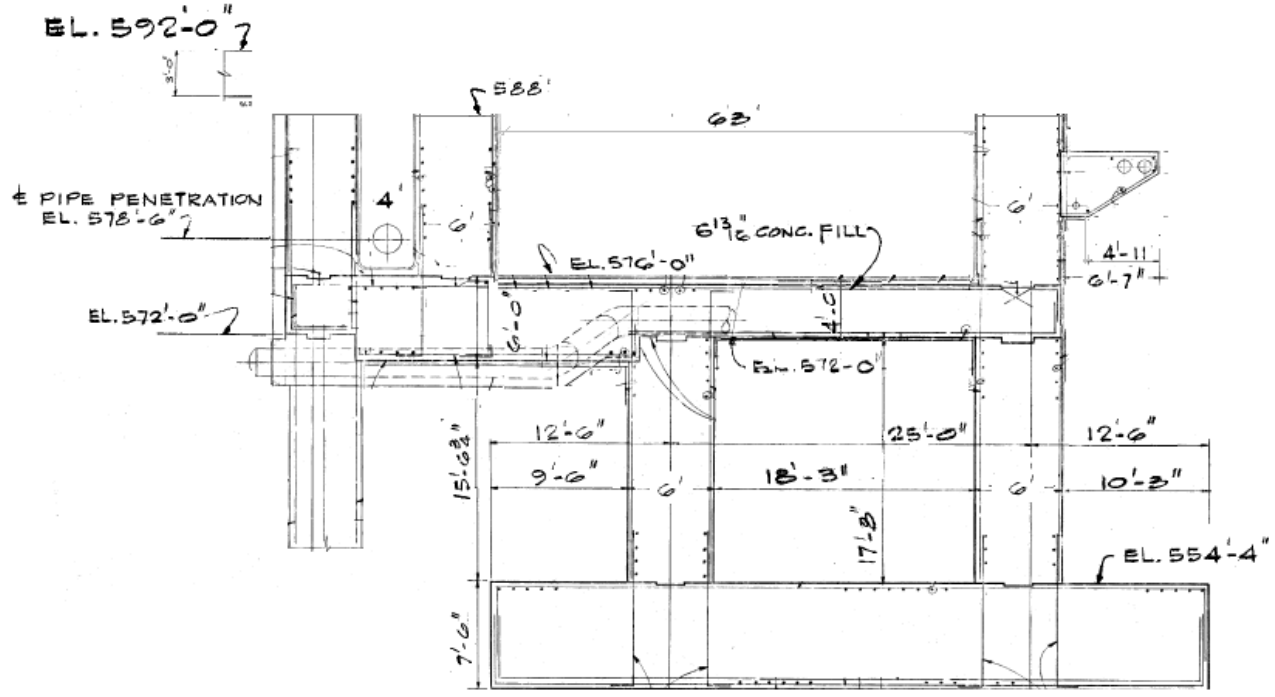


Figure 36 - Spent Fuel Pool and Transfer Canal Side View

The West Wall and North Wall lengths are the 63 feet minus 4 feet and 33 feet minus 4 feet to account for the surface are covered by the cask pit walls. The area of the floor covered by the cask pit walls is 4'+1'6" multiplied times 9'3"as seen in Figure 37

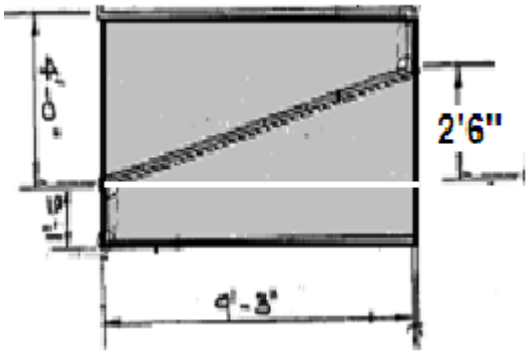


Figure 37 - Cask Pit Walls Floor Foot Print

The void space to the water table at 579' is calculated using the pool and canal floor surface areas in Table 56 as shown in Table 57.

Table 57 - Spent Fuel Pool and Transfer Canal Void Spaces to Water Table

Item	Floor Surface Area ft^2	Height to Water Table ft	Total Volume per Item ft^3
Spent Fuel Pool	2028.13	3.00	6084.38
Transfer Canal	423.17	3.00	1269.50
		Totals	**7353.88**

As seen in Figure 36, the floor under most of the Spent Fuel Pool is 4 feet thick and increases to 6 feet thick near the Transfer Canal. The concrete volumes of the walls and floors are shown in Table 58.

Table 58 - Spent Fuel Pool and Transfer Canal Wall and Floor Concrete Volumes

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
West Wall	63	12	6	4536	1	4536.00
East Wall	105.79	12	6	7617	1	7617.00
South Wall	39	12	6	2808	1	2808.00
North Wall	39	12	6	2808	1	2808.00
Cask Pit Walls	9.25	12	2.75	305.3	2	610.50
Pool Floor	51	33	4	6666	1	6666.00
Pool Floor	12.50	33	6	2475	1	2475.00
Transfer Canal East Wall	105.8	4	5.25	2222	1	2221.63
Transfer Canal Floor	105.8	15.25	6	9680	1	9679.94
			Totals	**39116.81**		**39422.06**

The dimensions of a potential abstracted model of the Spent Fuel Building are provided in Table 59.

Table 59 - Example of Abstracted Dimension for Spent Fuel Building Model

Description	Floor Elev ft	Length ft	Width ft	Floor Area ft^2	Height to Water Table ft	Void Space to WT ft^3
Spent Fuel Building	576	38.91	63	2451.29	3	7353.88

3.5. Containment Buttress Pits and Tendon Tunnel Access

There are 6 Tendon Buttress Pits equally spaced around each Containment (#s TBP1-1 through TBP1-6 and TBP2-1 through TBP 2-6) as seen in Figure 38. The most westerly TBP associated with each containment structure (TBP #1-1 & TBP #2-1) also provides access to the tendon tunnel at the west tendon tunnel sump. Access into the TBP is through 2 removable slabs in the concrete cap at the 592'el. An access ladder extends down to the 565'el provide access to the bottom of the TBP.

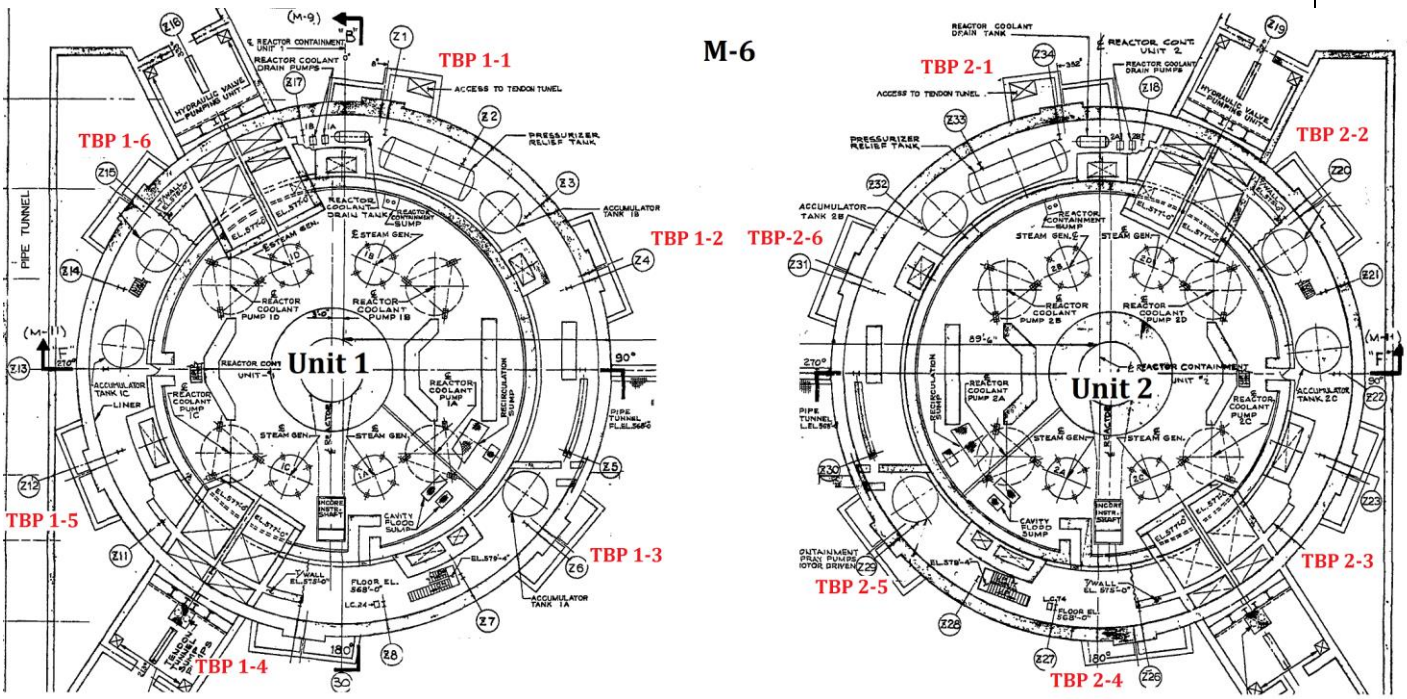


Figure 38 - Unit 1 and 2 Tendon Buttress Pits

The Tendon Buttress Pit below grade structures provide access to the containment horizontal tendons anchored in the buttresses. The structure consists of concrete walls from 591'6"elevation down to 565'el floor. The end state walls will be from the 588' to the 565' elevation or 23'. The inner vertical wall of the TBP is the outer radial wall of the containment which includes the tendon buttress which is 12' wide and protrudes from the containment wall approximately 1' 10". The 1'10" face at each end of the buttress has painted tendon end caps. The exterior containment wall and horizontal tendon buttresses continue above the 592'el to the top of the vertical exterior of the containment. The TBPs have a wall centered on the tendon buttress dividing the space into 2 chambers.

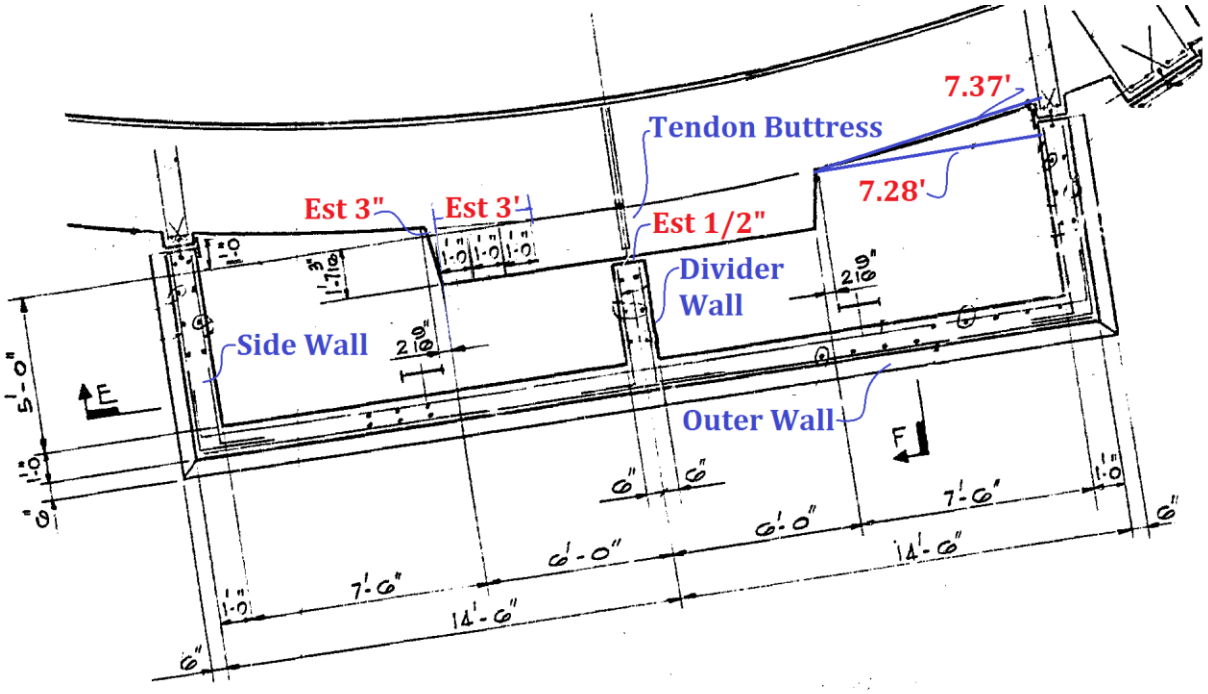


Figure 39 - Tendon Buttress Pits 2 through 6 Dimensions from B-249

A s seen in Figure 40, Tendon Buttress Pits 2 through 6 end states are 23’ high on the exterior and interior. The rectangular box shaped space is divided by a 23’ high vertical wall centered on the tendon buttress that extends out from the containment structure to the outer wall of the TBP forming 2 chambers.

The side walls are by 7’6” wide on the exterior and 6’1” interior that connect to the outer radius of the containment structure. The interior surface area of each side wall is 139.92 ft^2. The vertical side walls are 1’ thick resulting a concrete volume of each wall is 139.92 ft^3. The outer wall is 30 feet wide on the exterior with two interior surface areas due to the 1 foot thick center divider wall. This results in a 6’6”+ 6’6” or 13 foot width for each of the back wall interior surfaces or 26’ overall for 600.5 ft^2. The concrete volume of the outer wall is 30 feet by 1 foot thick by 23’ for a concrete volume of 690 ft^3. The width of the interior divider wall, as seen in Figure 39, is 5’3”-1’7 3/16”-1/2” or 3.15 feet. This equals an interior surface area of one side of 72.47 ft^2.

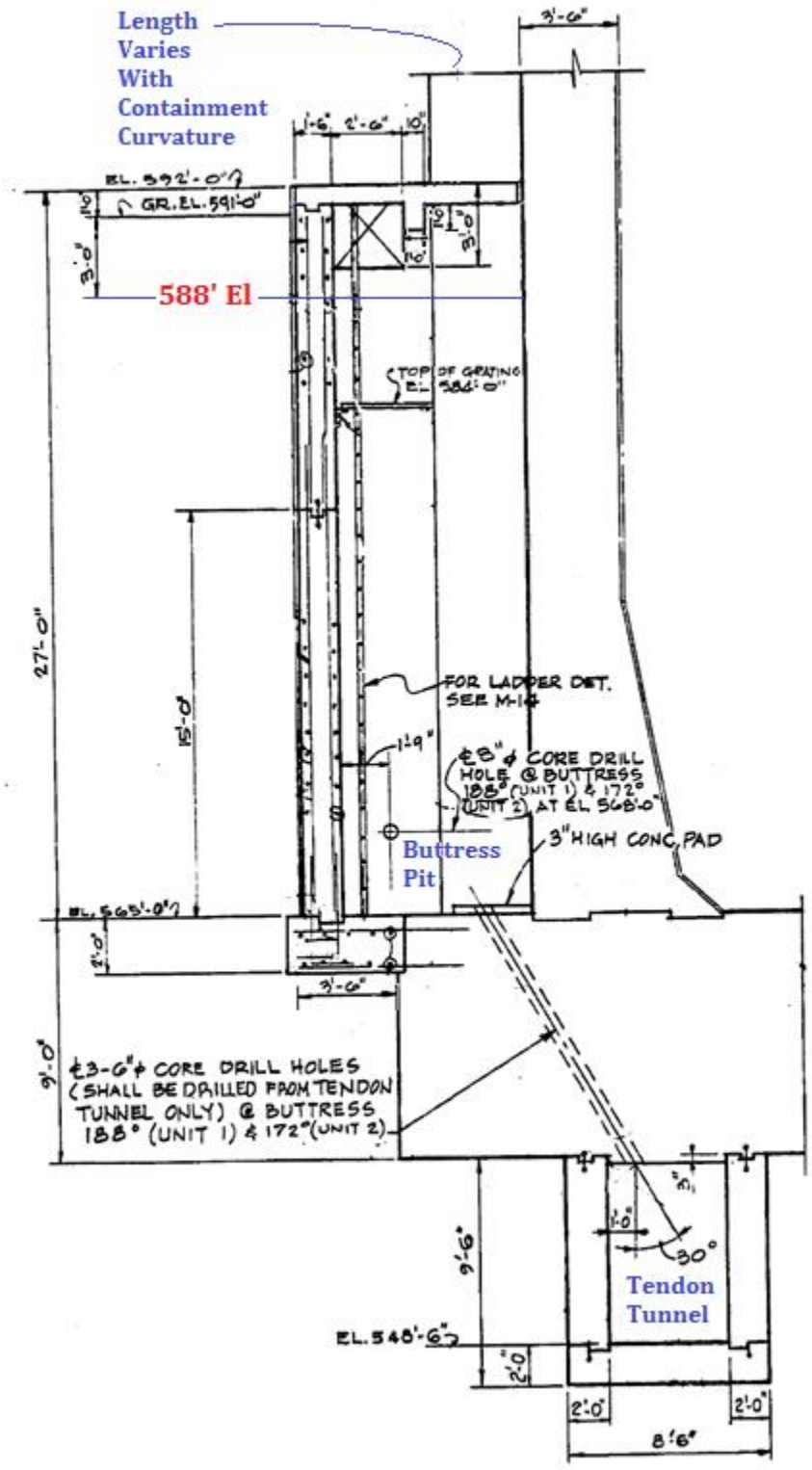
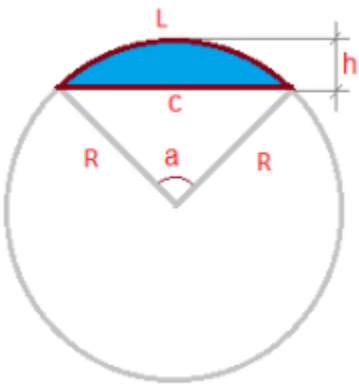


Figure 40 - Tendon Buttress Pit 2 - 6 Side View Section FF B-235

As seen in Figure 39, the divider wall abuts to within ½" of the Tendon Buttress. The Tendon Buttress has two angle sides that extend the full 23 in elevation. The width is the hypotenuse of a 1'

7 3/16" +3" opposite and 2 9/16" base or 1.861' equaling a surface area of 42.81 ft^2 per side or 85.62 ft^2 for both. The flat surface of the Tendon Buttress is 23' high by 12' for a surface area of 276 ft^2. The concrete volume of the two angled sides of the Tendon Buttress is 42.81 ft^2 x 2 9/16" thickness or 9.1 ft^3. The Volume of the flat center portion of the Tendon Buttress is 12'-2 19/16"-2"9/16" or 23' x 11.57' x 1'7 3/16" or 426 ft^3. As seen in Figure 39, there two wedges at either end of the center section approximately 2" x 3' created by the curvature of the Containment. This provides an additional volume of 23' x 2" x 3' resulting in an additional concrete volume of 11.5 ft^3.

As seen in Figure 39, the Containment outer wall section between the Tendon Buttress and the Side Wall is 7'6"-2 9/16" or 7.28'. B-223 shows the radius to the outer surface of Containment to be 73'6" making the circumference 461.81'. The curved face of the containment between the Tendon Buttress and the Side Walls is a Circular Segment as seen in Figure 39 and Figure 41. The cord length is the hypotenuse of the 1'1" base and 7.28' opposite or 7.37'.



Circular segment

On the picture:
L - arc length
h- height
c- chord
R- radius
a- angle

Area:

$$A = \frac{1}{2}R^2(\alpha - \sin\alpha)$$

Arc length:

$$L = \alpha R$$

Chord length:

$$c = 2R\sin\frac{\alpha}{2}$$

Segment height:

$$h = R\left(1 - \cos\frac{\alpha}{2}\right)$$

Figure 41 - Circular Segment Equations

The angle of the curved face of the containment exterior wall between the Tendon Buttress and the Side Wall can be calculated using Equation 1 .

Equation 1 – Angle and Arc Length Circular Segment

,

$$c = 2Rsin\frac{\propto}{2}$$

$$\propto_{radians} = ASIN\left(\frac{c}{R}\right) = ASIN\left(\frac{7.37}{73.5}\right) = 0.100394$$

$$L = \propto R = 0.100394 \times 73.5 = 7.38$$

In this case the arc length is virtually the same as the cord length which is evident in Figure 39. The surface area of each section between the Tendon Buttress and the Side Wall is 7.38' x 23' or 169.7

ft^2. The volume of the Containment wall concrete is already calculated and included in TSD 13-005 (2).

The 565' floor is 27' long by 6'1" wide minus the Containment Wall Circular Segment and Tendon Buttress surface Areas as seen in Figure 42.

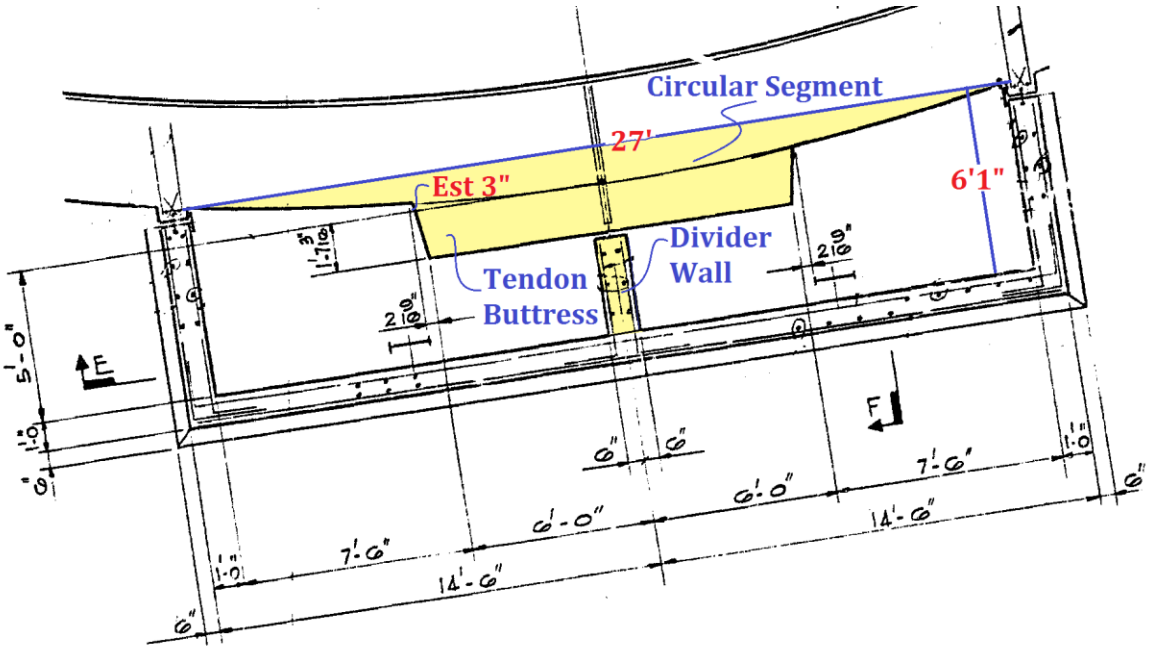


Figure 42 - B-249 Top Buttress Pit 565' Floor Surface Area Top Vies

The 27' by 6'1" Surface Area is 164.25 ft^2. As seen in Equation 1, the angle for the 27' cord is

$$\propto_{radians} = ASIN\left(\frac{c}{R}\right) = ASIN\left(\frac{27}{73.5}\right) = 0.376155$$

$$\propto_{degrees} = 0.376155\left(\frac{180}{\pi}\right) = 21.55^{o}$$

The area of the circular segment is shown in Equation 2.

Equation 2 - Surface Area of Circular Segment

$$A = \frac{1}{2}\,73.5^2(0.3607 - \sin 0.3607) = 23.79\ ft^2$$

The Tendon Buttress surface area is (12'+ 2 9/16") x (1' 7 3/16"+3") = 22.58 ft^2. The divider wall is 3.15' x 1' or 3.15 ft^2. The net surface area of the floor is 164.25 ft^2 – 23.79 ft^2 – 22.58 ft^2 – 3.15 ft^2 or 114.73 ft^2. The calculated surface areas are summarized in Table 60.

Table 60 - Single Unit Tendon Buttress Pit Surface Areas 2 though 6

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Side Wall 1	23	6.08	139.92	2	279.83
Outer Wall	23	26	600.5	1	600.5
Divider Wall	23	3.15	72.47	2	144.95
Divider Wall Facing CTMT	23	1.00	25.5	1	25.5
Tendon Buttress Sides	23	1.861	42.81	2	85.62
Tendon Buttress Center	23	12	276	1	276
CTMT Outer Buttress to Side Wall	23	7.38	169.7	2	339.43
Floor Over All	27	6.08	164.25	1	164.25
Circular Segment	27		-23.79	1	-23.79
Tendon Buttress	12.21	1.85	-22.58	1	-22.58
Divider Wall	3.15	1.00	-3.15	1	-3.15
			Totals		**1866.56**
			Totals 2 thu 6	5	**9332.78**

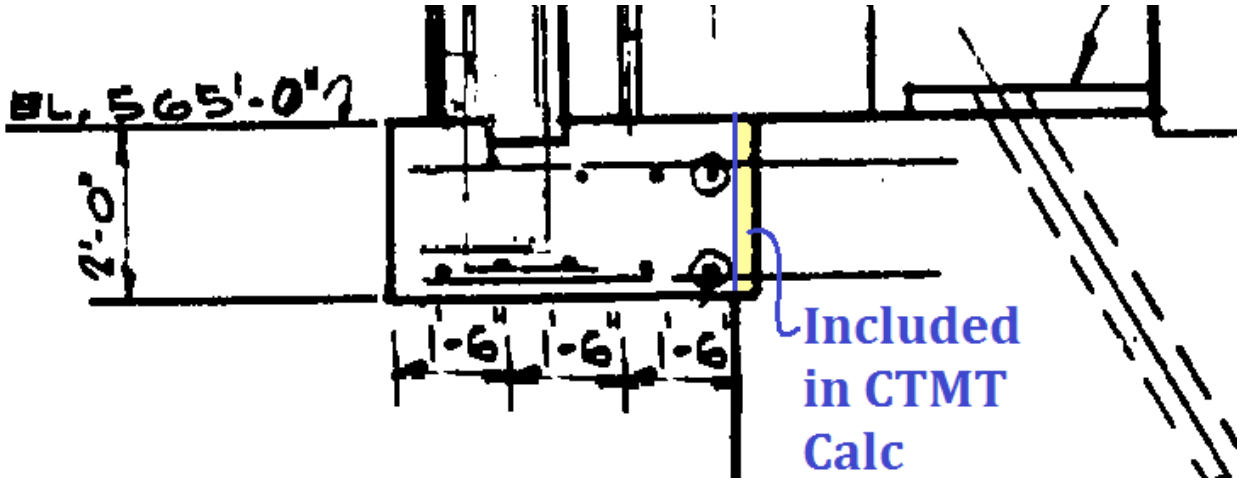


Figure 43 - Tendon Buttress Pit End Relative to Containment Foundation

As seen in Figure 43, a portion of the Buttress Pit floor rests on the Containment Foundation whose concrete volume is included in TSD 13-005 (2) with the ends overhanging it by about 4'6" at the ends as seen in Figure 43 and Figure 44. The area of the floor extending beyond the foundation is 4.6 x 30 minus or 135 ft^2 the area of the circular segments highlighted in yellow. B-223 shows the radius of the Containment foundation to be 78'6". The cord is 30 feet and the angle is 0.392139 radians.

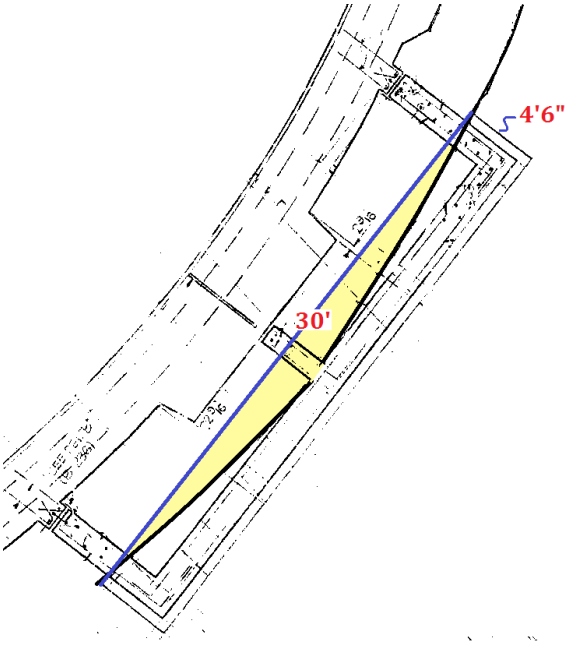


Figure 44 - Containment Foundation Below Buttress Pit Floor

The circular segment area in 30.728 ft^2 making the portion that extends past the foundation for an area of 135 ft^2 – 30,728 ft^2 or 104.27 ft^2. As seen in Figure 43, the floor under the Buttress Pit is 2 feet thick making the concrete volume 208.54 ft^3. The Buttress Pit concrete volumes are summarized in Table 61.

Table 61 - Calculated Concrete Volumes for Buttress Pits 2 thru 6 (Single Unit)

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Side Wall 1	23	6.08	1	139.92	2	279.83
Outer Wall	23	30	1	690.00	1	690.00
Divider Wall	23	3.15	1	72.47	1	72.47
Tendon Buttress Sides	23	1.861	0.21	9.1	1	9.14
Tendon Buttress Center	23	11.57	1.60	426	1	425.61
Tendon Buttress Center End Wedges	23	3	0.17	11.5	1	11.5
Floor Beyond Foundation Overall	30	4.5	2	270	1	270.00
Foundation Circular Segment		-30.728	2	-61.46	1	-61.46
				Totals		**1697.10**
				Totals 2 thru 6	5	**8485.49**

The void space to the water table at the 579’ elevation is 579-565 or 14’ multiplied by the floor surface area of 114.73 ft^2 or 1,606.17 ft^3 as seen in Table 62.

Table 62 - Tendon Buttress Pits 2 thu 6 Void Space Below Water Table

Item	Floor Surface Area ft^2	Height to Water Table ft	Total Volume per Item ft^3
Single Pit	114.73	14.00	1606.17
Pits 2 thu 6 for a Unit	**Total**	5	8030.84

Unit 1 and Unit 2 Buttress Pits 1-1 and 2-1 have a different configuration than Pits 2 through 6 with an access to the Tendon Tunnel as seen in Figure 38.

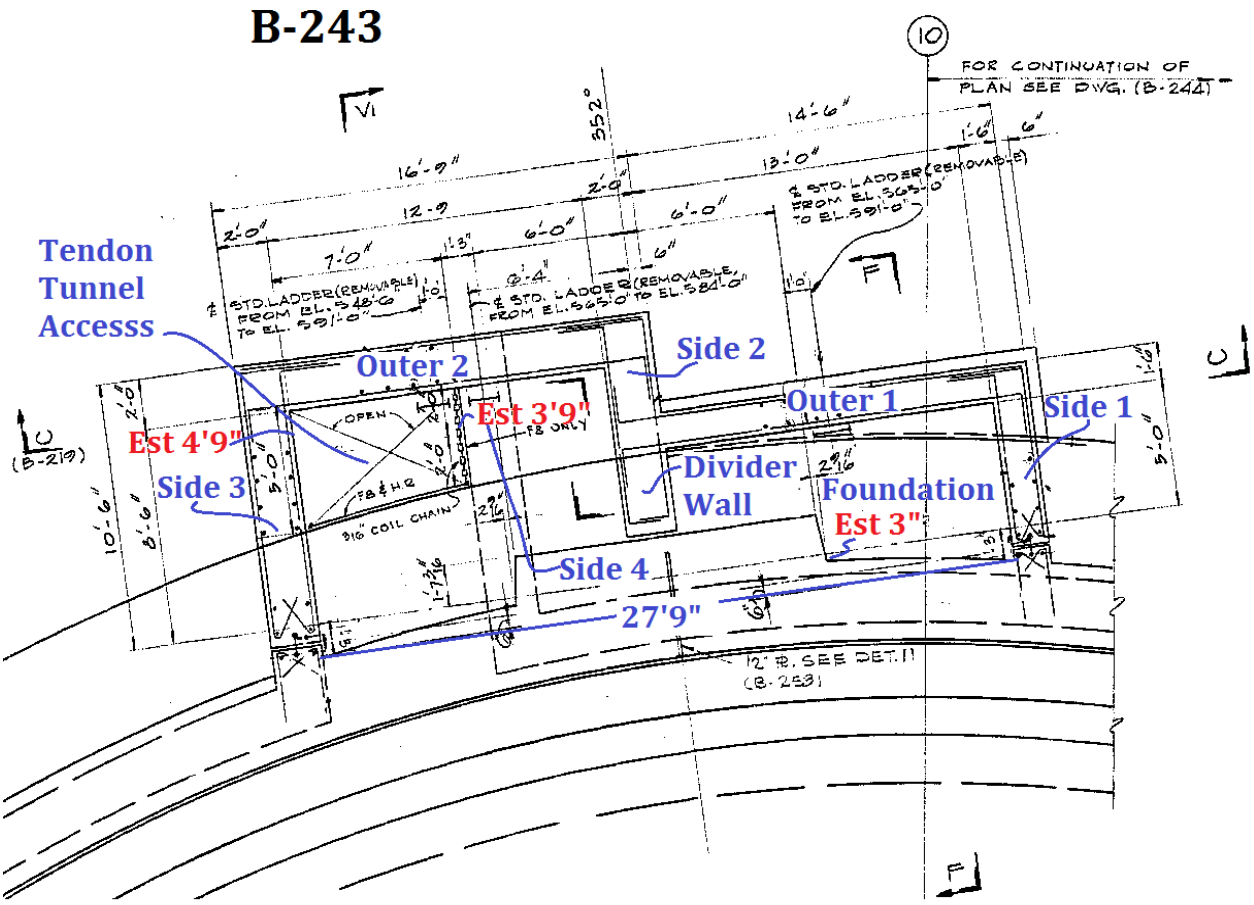


Figure 45 - Buttress Pit 1 Top View

As seen in Figure 45, the Unit 1 1-1 and Unit 2 2-1 western most Buttress Pits include an access to the Tendon Tunnel from floor of the Tendon Buttress Pits at the 565’ elevation to the floor of the Tendon Tunnel at the 548’6”. As seen in Figure 46, the roof is a 1’ thick concrete slab that extends

from the 592’ elevation to the 591’ elevation. The end state is 3 feet below that at the 588’ elevation. Side 1 is 1’6” thick and extends from the 588’ to the 565’ elevation or 23 feet as seen in Figure 47. The interior surface is 6’3” wide making the interior surface area 143.75 ft^2. The exterior wall is 7’9” making the concrete volume is 267.38 ft^3. Outer Wall 1 is 13 feet long, 1’6” thick and 23 feet high for an interior surface area of 301.5 ft^2. The concrete volume of Outer Wall 1 is 1’6” thick to the 580’ elevation and 2 feet thick from the 580’ to the 565’ elevation. Resulting in the upper portion being 156 ft^3 and the lower portion being 390 ft^3. The second side wall is 10’6” – 6’6” or 4 feet wide. The interior surface is 3’6” as seen in Figure 45. The top section of the Side Wall 2 is 1’6” thick from the 588’ to the 580” and 2 feet thick from the 578’6” to the 565’. The divider wall sides are 5’-1’7 3/16” – ½” or 2.9’ and extends from the 588’ to the 565’ elevation resulting is surface area of 66.72 ft^2 per side or 133.45 ft^2 total. The surface of the divider wall facing the containment wall is 2’ by 23 feet or 46 ft^2. The divider wall volume is 2.9’ x 2’ x 23’ or 133.45 ft^3. The divider wall surface facing the Containment is 23’ high by 2’ wide or 46 square feet.

Side wall 3 extends from the 588’ elevation to the 548’6” elevation or 40’ as seen in Figure 46. The walls is 1’6” thick to the 580 foot elevation resulting in 156 ft3, then is 2 feet thick from there to 548’6” resulting in . The wall interior width is 8’6” + 1’3” or 9’9” to the 565’ elevation. After that it is about 4’9” wide to the 548’6”. Side wall 4 from the 565’ to the 548’6” is 3’9” wide. Outer wall 2 surface area is 14’3” to the 565’ elevation and 7 feet from the 565’ to the 548’6”. The tendon buttress sides and center are the same as Table 60. The face of the containment wall to the right of the buttress is 13’-6’- 2 9/16” or 6.79’. The width is the square root of $6.79^2 + 1^2$ or 6.86’ making the surface rea to the 565’ elevation 157.8 ft^2. The left hand containment wall is 8’3”- 2 9/16” or 8.04’ making the hypotenuse 8.10 feet long for a total surface area of 186.26 ft^2. The portion of the Containment forming a wall next to the ladder is the hypotenuse of 7’ and 1’ or 7.07’ wide by 9’ long or 63.64 ft^2.

The floor area at 565’ is 13’ by 6’3” or 81.25 ft^2 and 12’9” by 9’9” or 121.31 ft^2. Minus the Circular segment with a cord of 14’9” and 13’ or 27’9” making the angle 0.38175 radians and the area of the circular segment 25.93 ft^2. The Tendon Buttress surface area is the same as in Table 60. The opening in the floor to the 548’6” elevation is 7’ by a 4’3” average width or 29.75 ft^2 making the net surface area 127.30 ft^2.

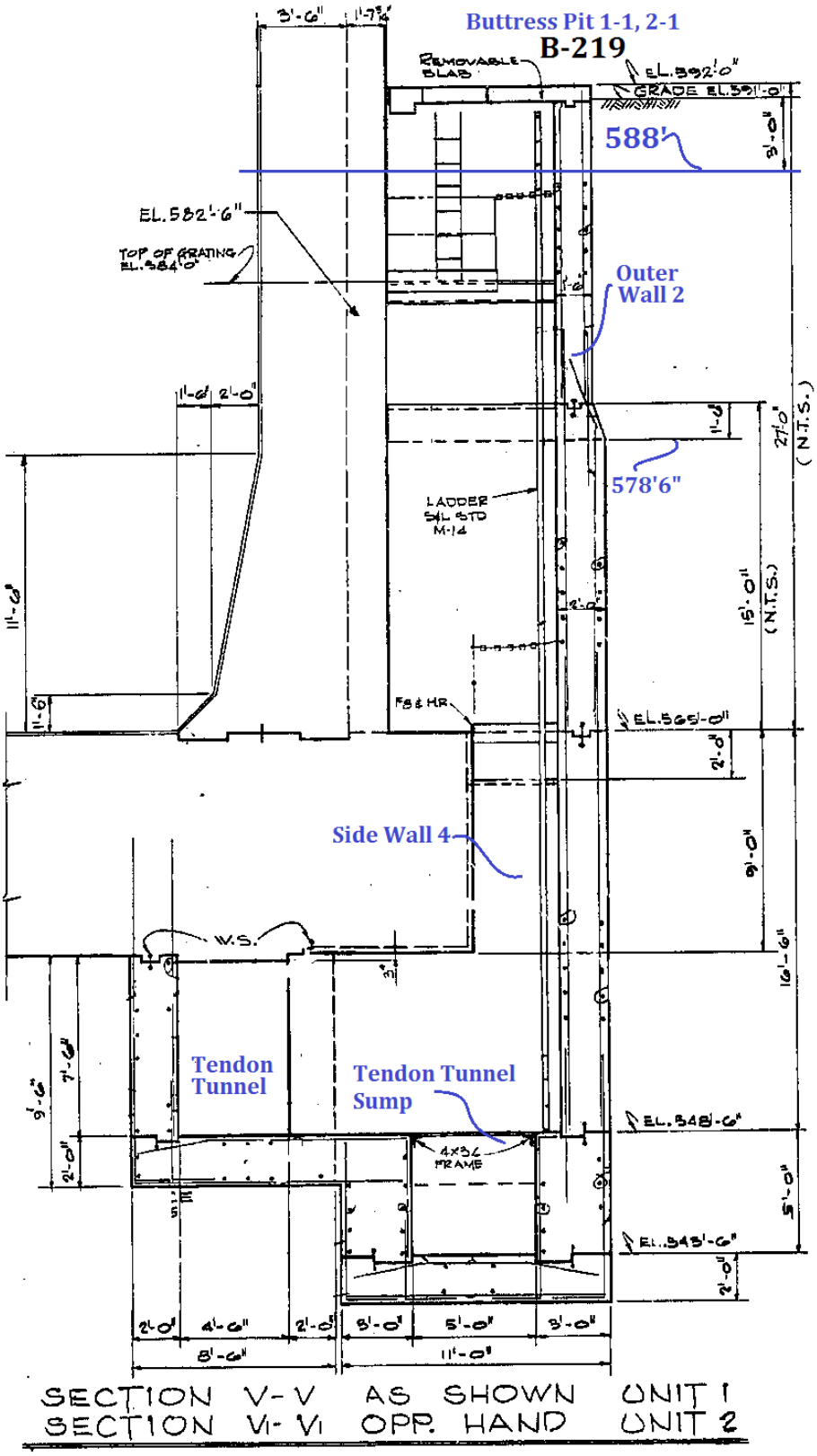


Figure 46 - Side View of Buttress Pit 1-1 and 2-1

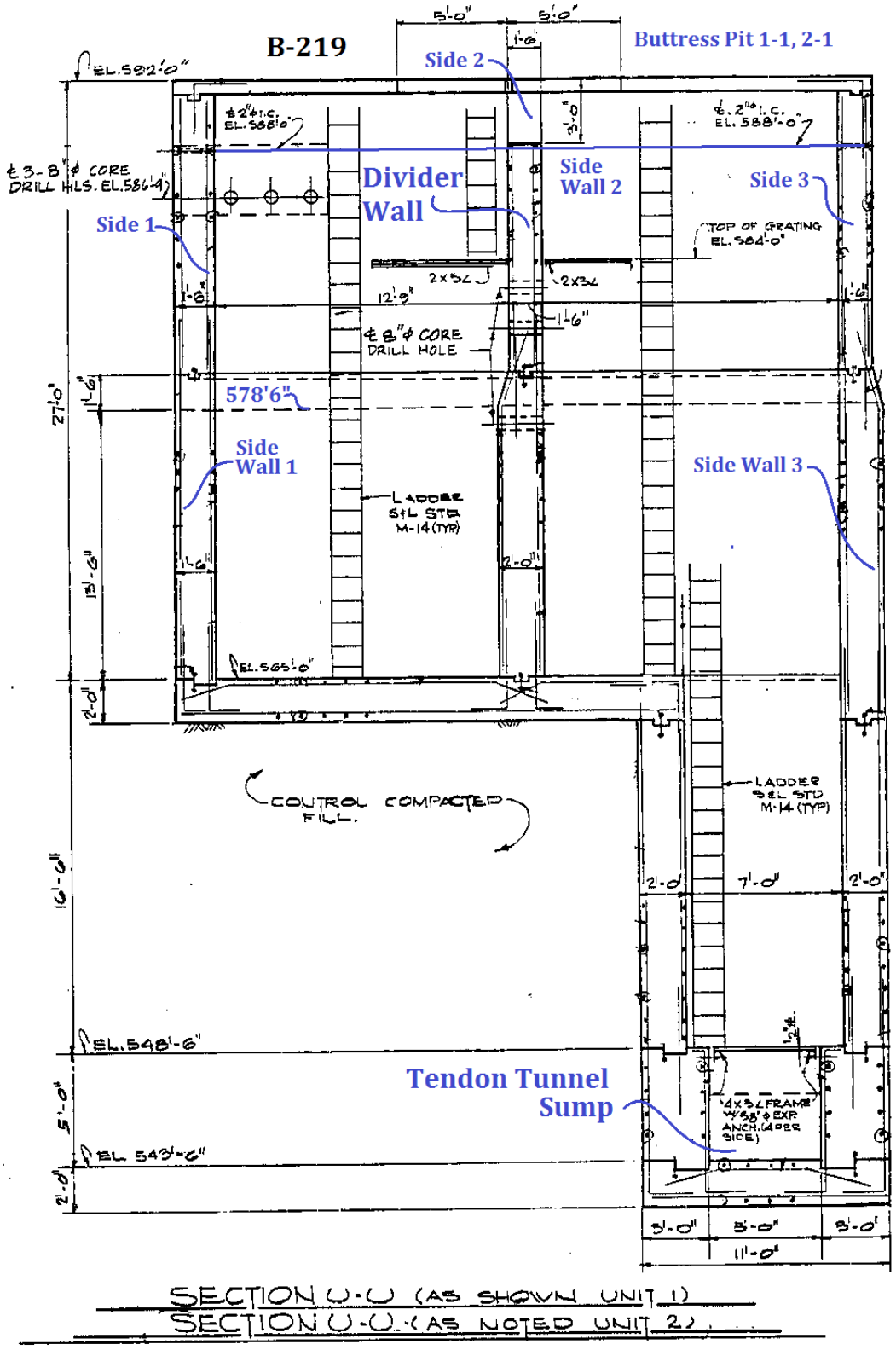


Figure 47 - Tendon Buttress Pits 1-1 and 2-1 Front View

There is an access area to the tendon tunnel traveling over the sump at the 548'6". The ceiling formed by the foundation is 7' wide by 2'+3'+2.5' or 52.5 ft^2. The tendon tunnel access walls are 16'6" – 9' 7'6" high by 4'6+2+3+5+1 or 15'6" for an area of 116.25 ft^2 per side. The floor area is 7' x 15'6" including the floor of the sump or 108.5 ft^2. The Sump Walls are 5' x 3' each for a total of 60 ft^2. The calculated surface areas for Tendon Buttress Pit 1-1 and 2-1 are provided in Table 63.

Table 63 - Calculated Surface Areas for Tendon Buttress Pits 1-1 and 2-1

Area	Length ft	Width ft	Surface Area	No Items	Total Surface Area ft^2
Side Wall 1 to 565'	23	6.25	143.75	1	143.75
Outer Wall 1	23	13	301.5	1	301.5
Side Wall 2 to 565'	23	3.50	80.50	1	80.50
Divider Wall	23	2.90	66.72	2	133.45
Divider Wall Face	23	2	46.00	1	46.00
Side Wall 3 to 565'	23	9.75	224.25	1	224.25
Side Wall 3 565' to 548'6"	16.5	4.75	78.38	1	78.38
Side Wall 4 565' to 548'6"	16.5	3.75	61.88	1	61.88
Outer Wall 2 to 565'	23	14.25	327.75	1	327.75
Outer Wall 2 565' to 548'6"	16.5	7	115.50	1	115.50
Tendon Buttress Sides	23	1.861	42.81	2	85.62
Tendon Buttress Center	23	12	276	1	276
CTMT Outer Buttress to Side Wall Right	23	6.86	157.8	1	157.77
CTMT Outer Buttress to Side Wall Left	23	8.10	186.3	1	186.26
CTMT Foundation	9	7.07	63.6	1	63.64
Floor Right	13	6.25	81.25	1	81.25
Floor Left	12.75	9.75	124.31	1	124.31
Circular Segment	27		-25.93	1	-25.93
Tendon Buttress	12.21	1.85	-22.58	1	-22.58
Floor Opening to 548'6"	7	4.25	-29.75	1	-29.75
Foundation Ceiling	7	7.5	52.50	1	52.50
Tunnel Access Walls	7.5	15.5	116.25	2	232.50
548'6" Floor Area	7	15.5	108.50	1	108.50
Sump Walls	5	3	15.00	4	60.00
	Totals				**2863.04**

The total surface area of the buttress pits is 9322.78 + 2863.04 or 12,195.83 ft^2.

The concrete volume of the walls are calculated using the wall thicknesses and lengths and widths. The 565' floor rests mainly on the 9' thick Containment foundation. The concrete volume of the foundation is included in the Concrete volume calculations in TSD 13-005. (2) B-223 shows the radius of the Containment foundation to be 78'6". The Pit 1 cord is 27'9" and the angle is 0.361313

radians resulting in a circular segment surface area of 24.06 ft^2. As seen in Figure 45, the distance from outer wall 2 to the containment foundation is interpolated at 4'9" feet. Making the left side floor surface area 4.75' x 7'+1'3"6'6" or 4.75 x 14.75' or 70.0625 ft^2 which at 2 feet thick makes the volume 140.125 ft^3. The right side is 8'6-5'-1'6" or 2' which makes the right side distance to Outer Wall 1 4.75'-2' or 2.75'. The width is 13' making the surface area 35.75 ft^2. The surface rea outside the foundation is 70.0625 ft^2 +35.75 ft^2 – 24.06 ft^2 and the 22.75 ft^2 of the floor opening to the 548'6" or 52 ft^2 net. At 2 feet thick this is a net concrete volume of 104 ft^3. The Tendon Tunnel Access side walls by the sump are 7'6" from the foundation down by 15'6" by 2' thick or 232.5 ft3 per wall which is 465 ft^3 overall. The floor area including the sump is 7' x 15'6" x 2' or 217 ft^3. The wall sof eth sump are 5' x 3' x 2' or 30 ft^3 each for a total of 120 ft^3. The estimated Buttress Pit 1-1 and 2-1 concrete volumes are summarized in Table 64.

Table 64 - Estimated Concrete Volumes for Buttress Pits 1-1 and 2-1

Item	Length ft	Width ft	Thickness ft	Concrete Volume per Item ft^3	No Items	Total Concrete Volume per Item ft^3
Side Wall 1	23	7.75	1.5	267.38	1	267.38
Outer Wall Top 1	8	13	1.5	156.00	1	156.00
Outer Wall Bottom 1	15	13	2	390.00	1	390.00
Side Wall 2 Top	8	4	1.5	48.00	1	48.00
Side Wall 2 Bottom	15	4	2	120.00	1	120.00
Divider Wall	23	2.90	2	133.45	1	133.45
Side Wall 3 Top	8	13	1.5	156.00	1	156.00
Side Wall 3 Bottom	31.5	13	2	819.00	1	819.00
Side Wall 4	16.5	3.75	2	123.75	1	123.75
Outer Wall 2 to 565'	23	14.25	2	655.5	1	655.50
Outer Wall 2 565' to 548'6"	8	7	2	112	1	112.00
565' Floor Left	4.75	14.75	70.0625			
565' Right side	2.75	13	35.75			
565' Foundation Circular Segment			-24.06			
Floor Opening to 548'6"	4.25	7	-29.75			
Floor Area Concrete Outside Foundation			2	104.00	1	104.00
Tendon Buttress Sides	23	1.861	0.21	9.1	1	9.14
Tendon Buttress Center	23	11.57	1.60	426	1	425.61
Tendon Buttress Center End Wedges	23	3	0.17	11.5	1	11.5
Tunnel Access Walls	7.5	15.5	2	232.5	2	465.00
548'6" Floor Area	7	15.5	2	217	1	217.00
Sump Walls	5	3	2	30	4	120.00
		Totals				**4333.32**

The total concrete volume for the buttress pits associated per unit is 8489.45 ft^3 for pits 2-6 and 433.32 ft^3 for pit 1 or 12,818,81 ft^3.

The void space below the 579' water table is Table 65.

Table 65 - Pit 1 Void Space Below Water Table at 579'

Item	Floor Surface Area ft^2	Height to of Void ft	Total Volume per Item ft^3
To 565'	127.30	14.00	1782.22
Opening Beside Foundation	29.75	9	267.75
Tunnel Access 548'6"	108.50	7.5	813.75
Tendon Tunnel Sump	5	3	15.00
Pit 1 Water Table Void Space	**Total**	33.50	2878.72

The total void space below the water table per unit for buttress pits is 2878.72 ft^3 + 8,0.30.84 ft^3 or 10,909.56 ft^3.

4. CONCLUSION

As seen in Table 66, the ancillary buildings include structures with low contamination levels and large surface areas and void spaces. The Spent Fuel Pool, Transfer Canal and WWTF will require additional characterization when their use is discontinued.

Table 66 - Summary of Ancillary Building Surface Areas, Water Table Void Space, and Concrete Volumes

Structure	Total Wall and Floor Surface Area ft^2 below 588' Elevation	Total Water Table Void Volume to 579 ft per Item ft^3	Total Water Table Void Volume to 579 ft per Item m^3	Total Concrete Volume per Item ft^3
Unit 1 Containment Liner Only	2.97E+04	230,881	6,538	
Unit 2 Containment Liner Only	2.97E+04	230,881	6,538	
Auxiliary Building	7.00E+04	1,003,735	28,423	5.20E+05
Turbine Bld, Main Steam Tunnel, Diesel Oil	1.65E+05	920,193	26,057	1.12E+06
Unit 1 Discharge Tunnel	2.62E+04	105,650	2,992	1.16E+05
Unit 2 Discharge Tunnel	2.62E+04	105,650	2,992	1.16E+05
Crib House and Forebay	1.49E+05	923,738	26,157	5.05E+05
Waste Water Treatment Facility	1.21E+04	5,082	144	1.27E+04
Spent Fuel Building	7.78E+03	7,354	208	3.94E+04
Buttress Pits	1.22E+04	10,910	309	1.28E+04
Totals	**3.98E+05**	**2.08E+06**	**5.89E+04**	**1.92E+06**

5. REFERENCES

1. **TSD 14-013 Zion Auxiliary Building End Sate Estimated Concrete Volumes, Surface Areas, and Source Terms.**

2. **TSD 13-005 Unit 1 &2 Reactor Building Estimated End State Concrete and Liner Volumes and Surface Areas.**

3. **Zion Nuclear Power Station, Units 1 And 2 Asset Sale Agreement, December 11, 2007.**

6. ATTACHMENTS

None