Culvert Quantity Summary

CRS:	BEL-148-8.28
PID:	112669
Design, Date:	LNW, 08/20/25
Check, Date:	SAH, 09/01/25

ITEM 511 - CLASS QC1 CONCRETE, RETAINING WALL/WINGWALL NOT INCLUDING FOOTING	***TOTAL: 8.00 C.Y. (USE 8 C.Y.)***
ITEM 511 - CLASS QC1 CONCRETE, FOOTING	***TOTAL: 23.24 C.Y. (USE 24 C.Y.)***
ITEM 511 - CLASS QC1 CONCRETE, HEADWALL	***TOTAL: 0.80 C.Y. (USE 1 C.Y.)***
ITEM 512 - TYPE 2 WATERPROOFING	***TOTAL: 221.67 S.Y. (USE 222 S.Y.)***
ITEM 516 - 1" PREFORMED EXPANSION JOINT FILLER	***TOTAL: 30.00 S.F. (USE 30 S.F.)***
ITEM 518 - POROUS BACKFILL WITH GEOTEXTILE FABRIC	***TOTAL: 10.44 C.Y. (USE 11 C.Y.)***
ITEM 512 - SEALING OF CONCRETE SURFACES (EPOXY-URETHANE)	***TOTAL: 36.87 S.Y. (USE 37 S.Y.)***
ITEM 503 - UNCLASSIFIED EXCAVATION (WINGWALL FOOTING)	***TOTAL: 172.90 C.Y. (USE 173 C.Y.)***

Culvert Quantity Calculations

CRS:	BEL-148-8.28
PID:	112669
Design, Date:	LNW, 08/20/25
Check, Date:	SAH, 09/01/25

Inlet Headwall Type	A
Outlet Headwall Type	A

ITEM 511 - CLASS QC1 CONCRETE, RETAINING WALL/WINGWALL NOT INCLUDING FOOTING — **TOTAL: 8.00 C.Y.**

$$Wingwall\ Volume = \left(L * \frac{(H+h)}{2} * b\right) + \left(b^2 tan\left(\frac{\theta}{2}\right) * H\right)$$

INLET HEADWALL

Left Side

(8.50 * (7.50 + 4.50)/2 * 1.00) + (1.00^2 * TAN(45.00/2) * 7.50) / 27 =

(51.00 + 3.11) C.F. / 27 = Left Side: 2.00 C.Y.

Right Side

(8.50 * (7.50 + 4.50)/2 * 1.00) + (1.00^2 * TAN(45.00/2) * 7.50) / 27 =

(51.00 + 3.11) C.F. / 27 = Right Side: 2.00 C.Y.

Total Inlet Vol: 4.00 C.Y.

OUTLET HEADWALL

Left Side

(8.50 * (7.50 + 4.50)/2 * 1.00) + (1.00^2 * TAN(45.00/2) * 7.50)/ 27=

(51.00 + 3.11) C.F. / 27= Left Side 2.00 C.Y.

Right Side

(8.50 * (7.50 + 4.50)/2 * 1.00) + (1.00^2 * TAN(45.00/2) * 7.50) / 27 =

(51.00 + 3.11) C.F. / 27 = Right Side 2.00 C.Y.

Total Outlet Vol: 4.00 C.Y.

Total Wingwall Vol: 8.00 C.Y.

ITEM 511 - CLASS QC1 CONCRETE, FOOTING — TOTAL: 23.24 C.Y.

$$Footer\ Area = 2w_fL + w_f(SPAN + 2 * t\ box,wall) + 2\left(w_f - a\right)^2 tan\frac{\theta}{2} - 2a^2 tan\frac{\theta}{2}$$

$$Cutoff\ Area = 2w_fL + 1.5 * (SPAN + 2 * t\ box,wall) - 2 * 1.5^2 tan\frac{\theta}{2}$$

$$Closure\ Pour = [(2 * t\ box,wall + SPAN) * a] * t\ box,bot\ /\ 27$$

INLET FOOTER

Main Section

((2 * 8.50 * 5.00) + (8.00 + 2 * 0.67) * 5.00 - 2 * 1.50^2 * TAN(45)/2) + 2 * (5.00 - 1.50)^2 * TAN(45)/2)) * 1.50 / 27 =
(85.00 + 46.70 + 10.15 - 1.86) * 1.50 / 27 =

Volume: 7.78 C.Y.

Cutoff Wall

((2 * 8.50 * 1.50) + (8.00 + 2 * 0.67) * 1.50 - 2 * 1.50^2 * TAN(45.00)/2)) * 2.50 / 27 =
(25.50 + 14.01 - 1.86) * 2.50 / 27 =

Cutoff Wall: 3.49 C.Y.

Closure Pour

((2 * 0.67 + 8.00) * 1.50) * 0.67/ 27 =

Closure Pour: 0.35 C.Y.

Total Inlet Vol:	**11.62**	**C.Y.**

OUTLET FOOTER

Main Section

((2*8.50*5.00)+(8.00+2*0.67)*5.00-2*1.50^2*TAN(45.00)/2)+2*(5.00-1.50)^2*TAN(45.00)/2))*1.50/27=
(85.00+46.70+10.15-1.86)*1.50/27=

Volume: 7.78 C.Y.

Cutoff Wall

((2*8.50*1.50)+(8.00+2*0.67)*1.50-2*1.50^2*TAN(45.00)/2))*2.50/27=
(25.50+14.01-1.86)*2.50/27=

Cutoff Wall: 3.49 C.Y.

Closure Pour

((2*0.67+8.00)*1.50)*0.67/27=

Closure Pour: 0.35 C.Y.

Total Outlet Vol:	**11.62**	**C.Y.**
Total Footer Volume:	**23.24**	**C.Y.**

ITEM 511 - CLASS QC1 CONCRETE, HEADWALL — TOTAL: 0.80 C.Y.

$$Abutment\ Foreslope\ Wall = [(H - (t\ box,top + t\ box,bot) - BoxHeight) * (BoxSpan + 2 * t\ box,wall) * b]\ /\ 27$$

Inlet Headwall

[(7.50-(0.67+0.67)-5.00)*(8.00+2*0.67)*1.00]/27=

Total Inlet Headwall:	**0.40**	**C.Y.**

Outlet Headwall

[(7.50-(0.67+0.67)-5.00)*(8.00+2*0.67)*1.00]/27=

Total Outlet Headwall:	**0.40**	**C.Y.**
Total Headwall Volume:	**0.80**	**C.Y.**

ITEM 512 - TYPE 2 WATERPROOFING
TOTAL: 221.67 S.Y.

$$Sides = 2 * BoxLength * (BoxRise + t\ box, bot + t\ box, top)$$
$$Top = (SPAN + 2 + 2 * t\ box, wall) * (BoxLength - b_{Inlet} - b_{Outlet})$$

Sides of box including 1' overlap on each wingwall	(2*84.00*(5.00+0.67+0.67))/9= **118.35 S.Y.**	*Top of box with 1' overlap*	((8.00+2+2*0.67)*(84.00-1.00-1.00))/9= **103.32 S.Y.**

ITEM 516 - 1" PREFORMED EXPANSION JOINT FILLER **TOTAL: 30.00 S.F.**

$$Area = 2bH$$

Inlet HW		*Outlet HW*	
2*1.00*7.50=	**15.00 S.F.**	2*1.00*7.50=	**15.00 S.F.**

ITEM 518 - POROUS BACKFILL WITH GEOTEXTILE FABRIC **TOTAL: 10.44 C.Y.**

$$Volume = \frac{\left[P_{bt} * \frac{(h + H - 1.5 * 2)}{2} * L\right] + \left[P_{bt} * tan\left(\frac{\theta}{2}\right) * (2b + P_{bt}) * (H - 1.5)\right]}{27}$$

INLET FILL

Left Side

((1.50*(4.50+7.50-3.00)/2*8.50)+(1.50*TAN(45.00)/2)*(2*1.00+1.50)*(7.50-1.50)))/27=

(57.38 + 13.05)/27=

Volume: 2.61 C.Y.

Right Side

((1.50*(4.50+7.50-3.00)/2*8.50)+(1.50*TAN(45.00)/2)*(2*1.00+1.50)*(7.50-1.50)))/27=

(57.38 + 13.05)/27=

Volume: 2.61 C.Y.

Total Inlet Volume: 5.22 C.Y.

OUTLET FILL

Left Side

((1.50*(4.50+7.50-3.00)/2*8.50)+(1.50*TAN(45.00)/2)*(2*1.00+1.50)*(7.50-1.50)))/27=

(57.38+13.05)/27=

Volume: 2.61 C.Y.

Right Side

((1.50*(4.50+7.50-3.00)/2*8.50)+(1.50*TAN(45.00)/2)*(2*1.00+1.50)*(7.50-1.50)))/27=

(57.38+13.05)/27=

Volume: 2.61 C.Y.

Total Outlet Volume: 5.22 C.Y.

Total Backfill Volume: 10.44 C.Y.

ITEM 512 - SEALING OF CONCRETE SURFACES (EPOXY-URETHANE) — TOTAL: 36.87 S.Y.

Wingwalls:

$Back = 0.5 * \left(L + btan\left(\frac{\theta}{2}\right)\right)$ $Front = L * \frac{H+h}{2} - L * \frac{h-0.75}{2}$ $Top = bL + b^2 tan\left(\frac{\theta}{2}\right)$ $Side = 0.75b$

Headwalls:

$Top = bL + b^2 tan\frac{\theta}{2}$ $Back = 0.5L + 0.5b * tan\frac{\theta}{2}$ $Front = L * \frac{H+h}{2} - L * \frac{h-0.75}{2}$

$ESoB = 2 * RISE * t_{box}, wall$ $IWoB = 2 * RISE * 2$ $IToB = SPAN * 2$

Inlet Left

Top	Back	Front
1.00*8.50+1.00 ^ 2*TAN(45.00/2))= 8.91 S.F.	8.50*0.5+1.00*TAN(45.00/2))*0.5= 4.46 S.F.	(8.50*(7.50+4.50)/2)-((4.50-0.75)*8.50/2)= 35.06 S.F.

Side		
1.00*0.75= 0.75 S.F.	Volume:	49.18 S.F.

Inlet Right

Top	Back	Front
1.00*8.50+1.00 ^ 2*TAN(45.00/2))= 8.91 S.F.	8.50*0.5+1.00*TAN(45.00/2))*0.5= 4.46 S.F.	(8.50*(7.50+4.50)/2)-((4.50-0.75)*8.50/2)= 35.06 S.F.

Side		
1.00*0.75= 0.75 S.F.	Volume:	49.18 S.F.

Inlet Headwall

Top	Back	Front
1.00*(8.00+2*0.67)= 9.34 S.F.	(8.00+2*0.67)/2= 4.67 S.F.	(8.00+2*0.67)*(7.50-5.00-0.67-0.67)= 10.83 S.F.

Exposed Sides of Box	Inside Walls of Box	Inside Top of Box		
2*5.00*0.67= 6.70 S.F.	2*5.00*2= 20.00 S.F.	8.00*2= 16.00 S.F.	Volume:	67.54 S.F.

Total Inlet Volume:	**165.91**	**S.F.**

Outlet Left

Top	Back	Front
1.00*8.50+1.00 ^ 2*TAN(45.00/2))= 8.91 S.F.	8.50*0.5+1.00*TAN(45.00/2))*0.5= 4.46 S.F.	(8.50*(7.50+4.50)/2)-((4.50-0.75)*8.50/2)= 35.06 S.F.

Side		
1.00*0.75= 0.75 S.F.	Volume:	49.18 S.F.

Outlet Right

Top	Back	Front
1.00*8.50+1.00 ^ 2*TAN(45.00/2))= 8.91 S.F.	8.50*0.5+1.00*TAN(45.00/2))*0.5= 4.46 S.F.	(8.50*(7.50+4.50)/2)-((4.50-0.75)*8.50/2)= 35.06 S.F.

Side		
1.00*0.75= 0.75 S.F.	Volume:	49.18 S.F.

Outlet Headwall

Top	Back	Front			
1.00*(8.00+2*0.67)=	(8.00+2*0.67)/2=	(8.00+2*0.67)*(7.50-5.00-0.67-0.67)=			
9.34 S.F.	4.67 S.F.	10.83 S.F.			
Exposed Sides of Box	Inside Walls of Box	Inside Top of Box			
2*5.00*0.67=	2*5.00*2=	8.00*2=			
6.70 S.F.	20.00 S.F.	16.00 S.F.	Volume:	67.54	S.F.
			Total Inlet Volume:	**165.91**	**S.F.**
			Total Sealant Area:	**36.87**	**S.Y.**

ITEM 503 - UNCLASSIFIED EXCAVATION (WINGWALL FOOTING) — TOTAL: 172.90 C.Y.

$$Footer\ Area = 2w_f L + w_f(SPAN + 2 * t\ box,wall) + 2\left(w_f - a\right)^2 tan\frac{\theta}{2} - 2a^2 tan\frac{\theta}{2}$$

$$Cutoff\ Area = 2w_f L + 1.5 * (SPAN + 2 * t\ box,wall) - 2 * 1.5^2 tan\frac{\theta}{2}$$

Inlet

Footer Area * Height

((2*8.50*5.00)+(8.00+2*0.67)*5.00-2*1.50^2*TAN(45.00/2))+2*(5.00-1.50)^2*TAN(45.00/2)))*(1.50+878.00-876.00)/27=

(85.00 + 46.70 + 10.15 - 1.86) * 3.50 / 27 =

Volume: 18.15 C.Y.

Cutoff Wall

((2 * 8.50 * 1.50) + (8.00 + 2 * 0.67) * 1.50 - 2 * 1.50^2 * TAN(45.00)/2)) * 2.50 / 27 =

(25.50 + 14.01 - 1.86) * 2.50 / 27 =

Volume: 3.49 C.Y.

Total Inlet Excavation:	18.15 * 4 + 3.49 =	**76.09**	**C.Y.**

Outlet

Footer Area * Height

((2*8.50*5.00)+(8.00+2*0.67)*5.00-2*1.50^2*TAN(45.00/2))+2*(5.00-1.50)^2*TAN(45.00/2)))*(1.50+878.00-875.00)/27=

(85.00+46.70+10.15-1.86)*4.50/27=

Volume: 23.33 C.Y.

Cutoff Wall

((2*8.50*1.50)+(8.00+2*0.67)*1.50-2*1.50^2*TAN(45.00)/2))*2.50/27=

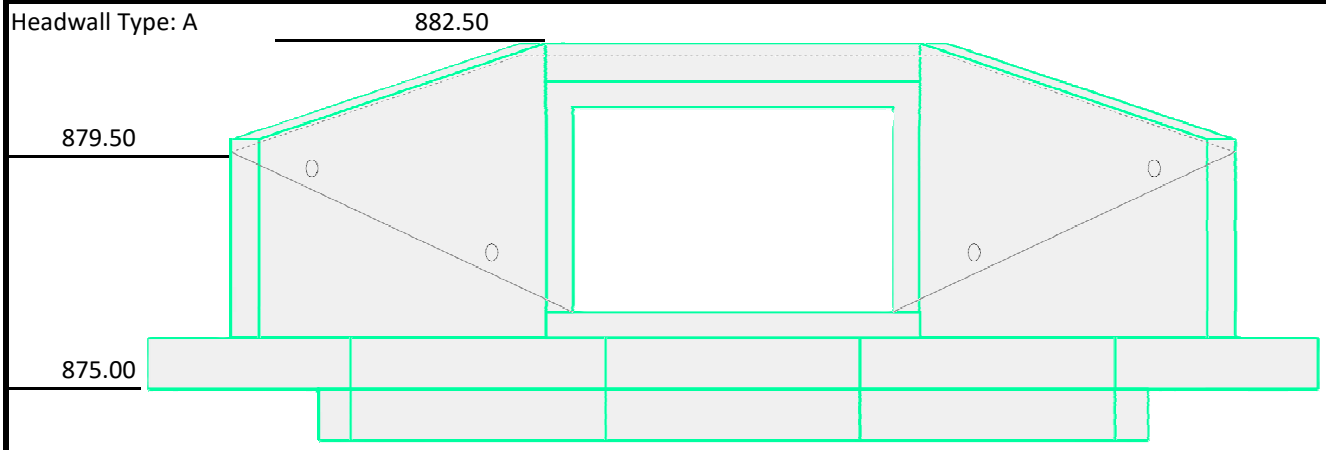
(25.50+14.01-1.86)*2.50/27=

Volume: 3.49 C.Y.

Total Outlet Excavation:	23.33 * 4 + 3.49 =	**96.81**	**C.Y.**
	Total Excavation Volume:	**172.90**	**C.Y.**

Inlet Headwall Elevations

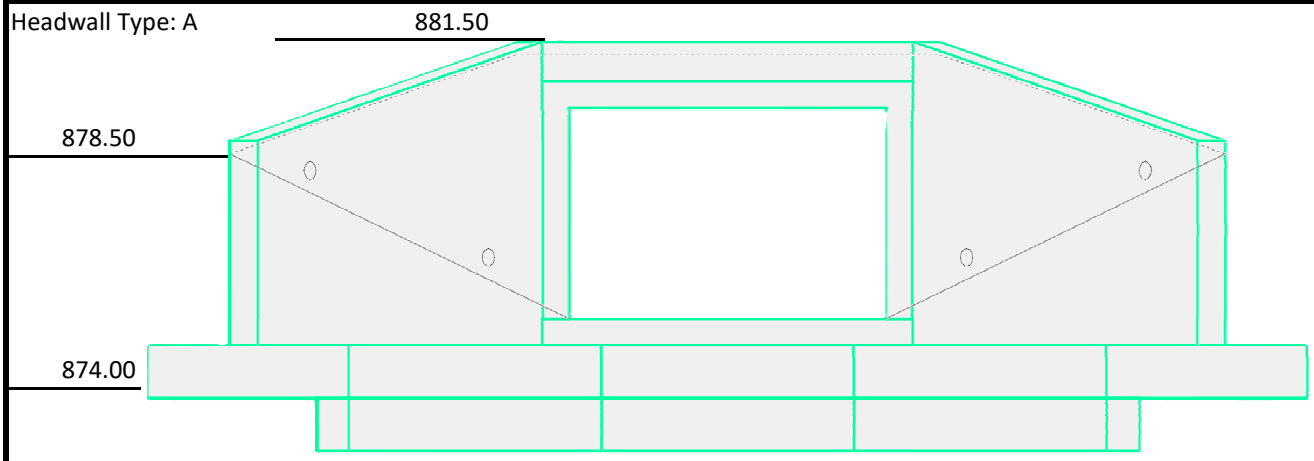
Headwall Type: A



Note: drawing may not accurately represent headwall, but elevations should be correct

Outlet Headwall Elevations

Headwall Type: A



Note: drawing may not accurately represent headwall, but elevations should be correct

Pavement Calculations

BEL-148-8.28
PID: 112669
By: TH/SH

*** includes 4 inch step**

 # includes 11 inch step

+ includes 18 inch extension per spec 204.03

Station		Side	Length	Begin Width	End Width	Average Width	Surface Area	Item 441 Surface Course		Item 301 *Asphalt Base		Item 304 #Aggregate Base		Item 204 +Subgrade Compaction	Item 407 Tack Coat	Item 408 Prime Coat, As Per Plan	Item 202 Pavement Removed
From	To							Thickness	CU. YD.	Thickness	CU. YD.	Thickness	CU. YD.				
Mainline Pavement				FT.	FT.	FT.	SQ. FT.							SQ. YD.	GAL.	GAL.	SQ. YD.
204+30.00	204+90.00	R	60.00	10.15	11.46	10.81	648.60	3.00"	6.01	7.00"	14.45	6.00"	13.03	82.07	11.89		72.03
204+30.00	204+90.00	L	60.00	10.56	10.54	10.55	633.00	3.00"	5.86	7.00"	14.11	6.00"	12.74	80.33	11.61		70.33
Shoulders																	
203+65.00	205+45.00	R	180.00	4	4	4	720.00					8.00"	17.78			32.00	
203+65.00	205+45.00	L	180.00	4	4	4	720.00					8.00"	17.78			32.00	
Totals - Carried to the General Summary									12		29		61	162	23	64	142