## E&S WORKSHEET # 11
## Channel Design Data

PROJECT NAME: ATLANTIC SUNRISE PROJECT - COMPRESSOR STATION # 605

LOCATION: CLINTON TOWNSHIP, WYOMING COUNTY, PA

PREPARED BY: AOE DATE: 08/01/2017

CHECKED BY: AJB DATE: 08/01/2017

| CHANNEL OR CHANNEL SECTION | | DITCH 1 | DITCH 5 | DITCH 6 | DITCH 8 | |
|---|---|---|---|---|---|---|
| TEMPORARY OR PERMANENT? | (T OR P) | P | P | P | P | |
| DESIGN STORM | (2, 5, OR 10 YR) | 10 | 10 | 10 | 10 | |
| ACRES | (AC) | 1.05 | 1.65 | 1.38 | 1.08 | |
| MULTIPLIER[1] | (1.6, 2.25, or 2.75)[1] | 2.75 | 2.75 | 2.75 | 2.75 | |
| Qr (REQUIRED CAPACITY) | (CFS) | 2.89 | 4.54 | 3.80 | 2.97 | |
| Q (CALCULATED AT FLOW DEPTH d) | (CFS) | 7.44 | 4.61 | 3.81 | 2.98 | |
| PROTECTIVE LINING[2] | | R-4 | R-4 | R-4 | R-4 | |
| n (MANNING'S COEFFICIENT)[2] | | 0.05 | 0.063 | 0.063 | 0.063 | |
| Va (ALLOWABLE VELOCITY) | (FPS) | N/A | N/A | N/A | N/A | |
| V (CALCULATED AT FLOW DEPTH d) | (FPS) | 2.07 | 2.99 | 2.47 | 2.50 | |
| τa (MAX ALLOWABLE SHEAR STRESS) | ($LB/FT^2$) | 2.00 | 2.00 | 2.00 | 2.00 | |
| τd (CALC'D SHEAR STRESS AT FLOW DEPTH d) | ($LB/FT^2$) | 0.58 | 2.00 | 1.37 | 1.42 | |
| CHANNEL BOTTOM WIDTH | (FT) | 2 | 2 | 2 | 2 | |
| CHANNEL SIDE SLOPES | (H:V) | 2 | 2 | 2 | 2 | |
| D (TOTAL DEPTH) | (FT) | 3.0 | 4.0 | 5.0 | 4.0 | |
| CHANNEL TOP WIDTH @ D | (FT) | 14 | 18 | 22 | 18 | |
| d (CALCULATED FLOW DEPTH) | (FT) | 0.93 | 0.51 | 0.51 | 0.42 | |
| CHANNEL TOP WIDTH @ FLOW DEPTH d | (FT) | 5.72 | 4.04 | 4.04 | 3.68 | |
| BOTTOM WIDTH: FLOW DEPTH RATIO | (12:1 MAX) | 2.15 | 3.92 | 3.92 | 4.76 | |
| d50 STONE SIZE | (IN) | 6 | 6 | 6 | 6 | |
| A (CROSS-SECTIONAL AREA) | (SQ. FT.) | 3.59 | 1.54 | 1.54 | 1.19 | |
| R (HYDRAULIC RADIUS) | | 0.58 | 0.36 | 0.36 | 0.31 | |
| S (BED SLOPE)[3] | (FT/FT) | 0.01 | 0.063 | 0.043 | 0.054 | |
| Sc (CRITICAL SLOPE) | (FT/FT) | 0.052 | 0.089 | 0.089 | 0.094 | |
| .7Sc | (FT/FT) | 0.036 | 0.062 | 0.062 | 0.066 | |
| 1.3Sc | (FT/FT) | 0.068 | 0.116 | 0.116 | 0.122 | |
| STABLE FLOW? | (Y/N) | Y | N | Y | Y | |
| FREEBOARD BASED ON UNSTABLE FLOW | (FT) | 0.1 | 0.1 | 0.1 | 0.1 | |
| FREEBOARD BASED ON STABLE FLOW | (FT) | 0.5 | 0.5 | 0.5 | 0.5 | |
| MINIMUM REQUIRED FREEBOARD[4] | (FT) | 0.5 | 0.5 | 0.5 | 0.5 | |
| DESIGN METHOD FOR PROTECTIVE LINING [5] PERMISSIBLE VELOCITY (V) OR SHEAR STRESS | (S) | S | S | S | S | |

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach E&S Worksheets 9 and 10. For TR-55 enter "N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged.
4. Minimum Freeboard is 0.5 ft. or ¼ Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

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## Channel Design Data

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PREPARED BY: AOE DATE: 08/01/2017

CHECKED BY: AJB DATE: 08/01/2017

| CHANNEL OR CHANNEL SECTION | | DITCH 9 | DITCH 10 | DITCH 11 | DITCH 13 | |
|---|---|---|---|---|---|---|
| TEMPORARY OR PERMANENT? | (T OR P) | P | P | P | P | |
| DESIGN STORM | (2, 5, OR 10 YR) | 10 | 10 | 10 | 10 | |
| ACRES | (AC) | 0.86 | 3.07 | 0.42 | 0.91 | |
| MULTIPLIER[1] | (1.6, 2.25, or 2.75)[1] | 2.75 | 2.75 | 2.75 | 2.75 | |
| Qr (REQUIRED CAPACITY) | (CFS) | 2.37 | 8.44 | 1.16 | 2.50 | |
| Q (CALCULATED AT FLOW DEPTH d) | (CFS) | 2.38 | 12.02 | 1.21 | 2.56 | |
| PROTECTIVE LINING[2] | | R-4 | R-4 | R-4 | R-4 | |
| n (MANNING'S COEFFICIENT)[2] | | 0.063 | 0.047 | 0.063 | 0.063 | |
| Va (ALLOWABLE VELOCITY) | (FPS) | N/A | N/A | N/A | N/A | |
| V (CALCULATED AT FLOW DEPTH d) | (FPS) | 1.88 | 2.46 | 1.55 | 2.15 | |
| τa (MAX ALLOWABLE SHEAR STRESS) | ($LB/FT^2$) | 2.00 | 2.00 | 2.00 | 2.00 | |
| τd (CALC'D SHEAR STRESS AT FLOW DEPTH d) | ($LB/FT^2$) | 0.80 | 0.71 | 0.56 | 1.05 | |
| CHANNEL BOTTOM WIDTH | (FT) | 2 | 2 | 2 | 2 | |
| CHANNEL SIDE SLOPES | (H:V) | 2 | 2 | 2 | 2 | |
| D (TOTAL DEPTH) | (FT) | 5.0 | 5.0 | 6.0 | 5.0 | |
| CHANNEL TOP WIDTH @ D | (FT) | 22 | 22 | 26 | 22 | |
| d (CALCULATED FLOW DEPTH) | (FT) | 0.44 | 1.14 | 0.30 | 0.42 | |
| CHANNEL TOP WIDTH @ FLOW DEPTH d | (FT) | 3.76 | 6.56 | 3.20 | 3.68 | |
| BOTTOM WIDTH: FLOW DEPTH RATIO | (12:1 MAX) | 4.55 | 1.75 | 6.67 | 4.76 | |
| d50 STONE SIZE | (IN) | 6 | 6 | 6 | 6 | |
| A (CROSS-SECTIONAL AREA) | (SQ. FT.) | 1.27 | 4.88 | 0.78 | 1.19 | |
| R (HYDRAULIC RADIUS) | | 0.32 | 0.69 | 0.23 | 0.31 | |
| S (BED SLOPE)[3] | (FT/FT) | 0.029 | 0.01 | 0.03 | 0.04 | |
| Sc (CRITICAL SLOPE) | (FT/FT) | 0.097 | 0.043 | 0.108 | 0.096 | |
| .7Sc | (FT/FT) | 0.068 | 0.030 | 0.076 | 0.067 | |
| 1.3Sc | (FT/FT) | 0.126 | 0.056 | 0.140 | 0.125 | |
| STABLE FLOW? | (Y/N) | Y | Y | Y | Y | |
| FREEBOARD BASED ON UNSTABLE FLOW | (FT) | 0.1 | 0.2 | 0.0 | 0.1 | |
| FREEBOARD BASED ON STABLE FLOW | (FT) | 0.5 | 0.5 | 0.5 | 0.5 | |
| MINIMUM REQUIRED FREEBOARD[4] | (FT) | 0.50 | 0.5 | 0.5 | 0.5 | |
| DESIGN METHOD FOR PROTECTIVE LINING [5] PERMISSIBLE VELOCITY (V) OR SHEAR STRESS | (S) | S | S | S | S | |

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach E&S Worksheets 9 and 10. For TR-55 enter "N/A" and attach appropriate Worksheets.
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