### 716.00 CULVERT PIPE (SSHC Section 718)

### 716.01 DESCRIPTION

A. This work shall consist of furnishing and installing culvert pipe. The contractor has the option to furnish any of the types of culvert pipe listed in the specifications.

### 716.02 CONSTRUCTION METHODS

A. Culvert List. The contractor is not permitted to order or deliver culvert pipe until a "culvert list" listing the correct sizes and lengths of pipe is furnished to him/her by the Project Manager.

B. Pipe Bedding

1. Pipe bedding is explained in the special plan for "Pipe Policy".
2. The following soil classifications are necessary to use the pipe special plans to determine correct bedding materials.

| ASTM D 2487 Description and Identification of Soils |  |  |  |
| :--- | :--- | :--- | :--- |
|  |  | SIEVE RANGE |  |
|  | COURSE | Passes 3-inch | Retained on 3/4-inch |
| GRAVEL | FINE | passes 3/4-inch | Retained on No. 4 |
|  |  |  |  |
|  | COURSE | Passes No. 4 | Retained on No. 10 |
| SAND | MEDIUM | Passes No. 10 | Retained on No. 40 |
|  | FINE | Passes No. 40 | Retained on No. 200 |
|  |  |  |  |
|  |  |  |  |

C. Temporary Culvert Pipe

1. The Districts will be responsible for making a determination (presumably during the plan-in-hand inspection) regarding whether or not to ask for new pipe.
2. Logistics Division maintains a list of pipe values which can be used to determine damages to the Department when pipe is not returned to us in usable condition.
D. Salvaged Culvert Pipe. The following listed examples and rules are given to help clarify removal and salvage of culvert pipe.
3. Rules
a. The decision to salvage or not to salvage the culvert pipe at each location must be made by the Inspector or Project Manager prior to beginning removal work on the culvert pipe, and the contractor must be advised of your decision prior to his/her commencing work on the removal.
b. Culvert pipe ordered salvaged and carefully removed by the contractor will be paid for as per the specifications even though after removal it is apparent that the removed pipe has no salvage value.
c. The contractor must carefully remove the culvert pipe to prevent damage to the culvert pipe.

## 2. Examples

a. The contractor is ordered to salvage the culvert pipe. The contractor carefully removes the culvert pipe. The culvert pipe has almost rusted through from the outside and really has no salvage value. The length of pipe removed will be included for payment.
b. The contractor is ordered to salvage the culvert pipe. After the pipe has been uncovered, it is apparent that it has very little salvage value. If the contractor is agreeable, the Inspector or Project Manager can rescind their salvage order and the contractor can complete the removal any way possible. The length of pipe removed under these conditions will not be included for payment.
c. The contractor is ordered to salvage the culvert pipe. The contractor is careless in removing the culvert pipe and damages it. The length of pipe removed less the damage length may be included for payment, or the Inspector or Project Manager may determine that there is no salvage value left in the culvert pipe and no payment will be made for salvaging the culvert pipe at this location.
d. The contractor is ordered to not salvage the culvert pipe. The contractor removes the culvert pipe and disposes of part of it. The contractor advises that the remaining removed pipe may be picked up by the Department. The Department may refuse to pick it up, inasmuch as all such material is the property of the contractor and it is his/her responsibility to properly dispose of such material. If the Department picks it up the lengths may be included for payment as salvaging culvert pipe or they may be picked up without payment
being made. The Inspector or Project Manager shall determine what is fair and just.
3. Decisions and Documentation
a. There will undoubtedly be conditions arising which are not entirely covered by these rules or examples but the Inspector or Project Manager should be able to make the proper decision within the spirit of these guidelines.
4. The project records must include pertinent notes explaining and detailing decisions made on salvaging culvert pipe.


## ADDITIONAL EXCAVATION FOR EMBANKMENT OR BACKFILL (Left in English Units for Your Convenience)

The following charts may be used for computing Additional Excavation for Embankment or Backfill for circular culvert pipe, arch culvert pipe or elliptical culvert pipe (pages 450C, D, E, F). "Y" is the distance from natural ground to the center of the pipe or in the case of arch pipe to the widest part of the pipe. The numbers in the columns under the different size pipe diameters are the end area in square feet of the backfill required by the specification.

Example: A 24" circular culvert pipe is laid at Station 17+30 with Flowline Lt. 2416.60 at 47' and Flowline Rt. 2415.00 at 51': The field design cross-section is 16.6 at 50 ' Lt., 16.3 at 35 ' Lt., 16.2 at
$18^{\prime}$ Lt., 16.2 at CL, 16.0 at $5^{\prime}$ Rt., 16.0 at $10^{\prime}$ Rt., 15.3 at $15^{\prime}$ Rt., 15.0 at $27^{\prime} R^{\prime}$., 15.7 at $42^{\prime} R t$. and 15.5 at 55 Rt.

| 16.6 at $50^{\prime}$ |  |  |
| :--- | :--- | :--- |
| 16.5 at $47^{\prime}$ | $\mathrm{FL}=16.6$ at $47^{\prime}$ | $\mathrm{Y}=1.1$ |
| 16.3 at $35^{\prime}$ | $\mathrm{FL}=16.4$ at $35^{\prime}$ | $\mathrm{Y}=1.1$ |
| 16.2 at $18^{\prime}$ | $\mathrm{FL}=16.1$ at $18^{\prime}$ | $\mathrm{Y}=0.9$ |
| 16.2 at CL | $\mathrm{FL}=15.8$ at CL | $\mathrm{Y}=0.6$ |
| 16.0 at $5^{\prime}$ | $\mathrm{FL}=15.8$ at $5^{\prime}$ | $\mathrm{Y}=0.8$ |
| 16.0 at $10^{\prime}$ | $\mathrm{FL}=15.7$ at $10^{\prime}$ | $\mathrm{Y}=0.7$ |
| 15.3 at $15^{\prime}$ | $\mathrm{FL}=15.6$ at $15^{\prime}$ | $\mathrm{Y}=1.3$ |
| 15.0 at $27^{\prime}$ | $\mathrm{FL}=15.4$ at $27^{\prime}$ | $\mathrm{Y}=1.4$ |
| 15.7 at $42^{\prime}$ | $\mathrm{FL}=15.1$ at $42^{\prime}$ | $\mathrm{Y}=0.4$ |
| 15.6 at $51^{\prime}$ | $\mathrm{FL}=15.0$ at $51^{\prime}$ | $\mathrm{Y}=0.4$ |
| 15.5 at $55^{\prime}$ |  |  |$\quad$|  | $24 " \times 98^{\prime}$ Culvert Pipe |
| :--- | :--- |

## Circular Culvert Pipe Embankment Areas <br> (Y=Height, TC = Center of Pipe)

Pipe Diagram

| Y | 12" | 15" | 18" | 24" | 30" | 36" | 42" | 48" | 54" | 60" | 72" |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.1 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| 0.2 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| 0.3 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| 0.4 | 2.0 | 2.0 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| 0.5 | 2.6 | 2.6 | 2.6 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 0.6 | 3.3 | 3.3 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.1 | 3.1 |
| 0.7 | 4.1 | 4.0 | 4.0 | 3.9 | 3.9 | 3.9 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 |
| 0.8 | 4.9 | 4.9 | 4.8 | 4.7 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.5 | 4.5 |
| 0.9 | 5.7 | 5.7 | 5.7 | 5.5 | 5.4 | 5.4 | 5.4 | 5.3 | 5.3 | 5.3 | 5.3 |
| 1.0 | 6.6 | 6.6 | 6.6 | 6.4 | 6.3 | 6.2 | 6.2 | 6.2 | 6.2 | 6.1 | 6.1 |
| 1.1 | 7.5 | 7.6 | 7.6 | 7.4 | 7.2 | 7.1 | 7.1 | 7.1 | 7.0 | 7.0 | 7.0 |
| 1.2 | 8.5 | 8.6 | 8.6 | 8.5 | 8.2 | 8.1 | 8.0 | 8.0 | 7.9 | 7.9 | 7.9 |
| 1.3 | 9.5 | 9.6 | 9.6 | 9.4 | 9.4 | 9.1 | 9.0 | 9.0 | 8.9 | 8.9 | 8.8 |
| 1.4 | 10.5 | 10.7 | 10.7 | 10.7 | 10.6 | 10.3 | 10.1 | 10.0 | 10.0 | 9.9 | 9.8 |
| 1.5 | 11.6 | 11.8 | 11.9 | 11.9 | 11.8 | 11.5 | 11.2 | 11.1 | 11.0 | 11.0 | 10.9 |
| 1.6 | 12.7 | 12.9 | 13.0 | 13.1 | 13.1 | 12.8 | 12.5 | 12.3 | 12.2 | 12.1 | 12.0 |
| 1.7 | 13.9 | 14.1 | 14.2 | 14.4 | 14.4 | 14.1 | 13.7 | 13.5 | 13.4 | 13.3 | 13.2 |
| 1.8 | 15.1 | 15.3 | 15.5 | 15.7 | 15.7 | 15.5 | 15.2 | 14.8 | 14.7 | 14.5 | 14.4 |
| 1.9 | 16.3 | 16.6 | 16.8 | 17.0 | 17.1 | 17.0 | 16.7 | 16.2 | 16.0 | 15.8 | 15.6 |
| 2.0 | 17.6 | 17.9 | 18.1 | 18.4 | 18.5 | 18.5 | 18.2 | 17.7 | 17.4 | 17.2 | 17.0 |
| 2.1 | 18.9 | 19.2 | 19.5 | 19.8 | 20.0 | 20.0 | 19.8 | 19.3 | 18.9 | 18.6 | 18.3 |
| 2.2 | 20.3 | 20.6 | 20.9 | 21.3 | 21.5 | 21.5 | 21.4 | 21.0 | 20.5 | 20.1 | 19.8 |
| 2.3 | 21.7 | 22.0 | 22.3 | 22.8 | 23.1 | 23.1 | 23.0 | 22.7 | 22.2 | 21.7 | 21.3 |
| 2.4 | 23.1 | 23.5 | 23.8 | 24.3 | 24.7 | 24.8 | 24.7 | 24.4 | 24.0 | 23.4 | 22.9 |
| 2.5 | 24.6 | 25.0 | 25.4 | 25.9 | 26.3 | 26.5 | 26.4 | 26.2 | 25.8 | 25.2 | 24.5 |
| 2.6 | 26.1 | 26.6 | 26.9 | 27.5 | 28.0 | 28.2 | 28.2 | 28.0 | 27.7 | 27.1 | 26.2 |
| 2.7 | 27.7 | 28.1 | 28.5 | 29.2 | 29.7 | 29.9 | 30.0 | 29.9 | 29.6 | 29.1 | 28.0 |
| 2.8 | 29.3 | 29.8 | 30.2 | 30.9 | 31.4 | 31.7 | 31.9 | 31.8 | 31.5 | 31.1 | 29.8 |
| 2.9 | 30.9 | 31.4 | 31.9 | 32.6 | 33.2 | 33.6 | 33.8 | 33.7 | 33.5 | 33.1 | 31.8 |
| 3.0 | 32.6 | 33.1 | 33.6 | 34.4 | 35.0 | 35.5 | 35.7 | 35.7 | 35.5 | 35.2 | 33.9 |
| 3.1 | 34.3 | 34.9 | 35.4 | 36.2 | 36.9 | 37.4 | 37.7 | 37.7 | 37.6 | 37.3 | 36.1 |
| 3.2 | 36.1 | 36.7 | 37.2 | 38.1 | 38.8 | 39.3 | 39.7 | 39.8 | 39.7 | 39.5 | 38.3 |
| 3.3 | 37.9 | 38.5 | 39.0 | 40.0 | 40.8 | 41.3 | 41.7 | 41.9 | 41.9 | 41.7 | 40.6 |
| 3.4 | 39.7 | 40.4 | 40.9 | 41.9 | 42.8 | 43.4 | 43.8 | 44.0 | 44.1 | 43.9 | 43.0 |
| 3.5 | 41.6 | 42.3 | 42.9 | 43.9 | 44.8 | 45.5 | 45.9 | 46.2 | 46.3 | 46.2 | 45.4 |
| 3.6 | 43.5 | 44.2 | 44.8 | 45.9 | 46.9 | 47.6 | 48.1 | 48.4 | 48.6 | 48.5 | 47.8 |
| 3.7 | 45.5 | 46.2 | 46.8 | 48.0 | 49.0 | 49.7 | 50.3 | 50.7 | 50.9 | 50.9 | 50.2 |
| 3.8 | 47.5 | 48.2 | 48.9 | 50.1 | 51.1 | 51.9 | 52.6 | 53.0 | 53.2 | 53.3 | 52.7 |
| 3.9 | 49.5 | 50.3 | 51.0 | 52.2 | 53.3 | 54.2 | 54.9 | 55.3 | 55.6 | 55.7 | 55.3 |
| 4.0 | 51.6 | 52.4 | 53.1 | 54.4 | 55.5 | 56.5 | 57.2 | 57.7 | 58.0 | 58.2 | 57.9 |
| 4.1 | 53.7 | 54.5 | 55.3 | 56.6 | 57.8 | 58.8 | 59.6 | 60.1 | 60.5 | 60.7 | 60.5 |
| 4.2 | 55.9 | 56.7 | 57.5 | 58.9 | 60.1 | 61.1 | 62.0 | 62.6 | 63.0 | 63.3 | 63.1 |
| 4.3 | 58.1 | 58.9 | 59.7 | 61.2 | 62.5 | 63.5 | 64.4 | 65.1 | 65.6 | 65.9 | 65.8 |
| 4.4 | 60.3 | 61.2 | 62.0 | 63.5 | 64.9 | 66.0 | 66.9 | 67.6 | 68.2 | 68.5 | 68.6 |
| 4.5 | 62.6 | 63.5 | 64.4 | 65.9 | 67.3 | 68.5 | 69.4 | 70.2 | 70.8 | 71.2 | 71.4 |
| 4.6 | 64.9 | 65.9 | 66.7 | 68.3 | 69.8 | 71.0 | 72.0 | 72.8 | 73. | 73.9 | 74.2 |
| 4.7 | 67.3 | 68.2 | 69.1 | 70.8 | 72.3 | 73.5 | 74.6 | 75.5 | 76.2 | 76.7 | 77.0 |
| 4.8 | 69.7 | 70.7 | 71.6 | 73.3 | 74.8 | 76.1 | 77.3 | 78.2 | 78.9 | 79.5 | 79.9 |
| 4.9 | 72.1 | 73.1 | 74.1 | 75.8 | 77.4 | 778.8 | 80.0 | 80.9 | 81.7 | 82.3 | 82.9 |
| 5.0 | 74.6 | 75.6 | 76.6 | 78.4 | 80.0 | 81.5 | 82.7 | 83.7 | 84.5 | 85.2 | 85.9 |

## Culvert Pipe-Arch Embankment Areas <br> ( $\mathrm{Y}=$ Height to Widest Section of Pipe) <br> Equivalent Round Size

| $\mathbf{Y}$ | $\mathbf{1 2 \prime \prime}$ | $\mathbf{3 0 \prime \prime}$ | $\mathbf{3 6 "}$ | $\mathbf{4 2 \prime \prime}$ | $\mathbf{4 8 \prime \prime}$ | $\mathbf{5 4 \prime \prime}$ | $\mathbf{6 0 \prime \prime}$ | $\mathbf{6 6 \prime \prime}$ | $\mathbf{7 2 \prime \prime}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.1 | 0.6 | 0.6 | 0.7 | 0.7 | 0.8 | 0.9 | 1.0 | 1.2 | 1.3 |
| 0.2 | 1.1 | 1.1 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.7 | 1.8 |
| 0.3 | 1.6 | 1.6 | 1.6 | 1.7 | 1.8 | 1.9 | 2.1 | 2.2 | 2.4 |
| 0.4 | 2.0 | 2.2 | 2.2 | 2.2 | 2.24 | 2.5 | 2.6 | 2.8 | 2.9 |
| 0.5 | 2.8 | 2.7 | 2.7 | 2.7 | 2.9 | 3.1 | 3.2 | 3.4 | 3.5 |
| 0.6 | 3.7 | 3.6 | 3.5 | 3.4 | 3.4 | 3.7 | 3.8 | 4.0 | 4.2 |
| 0.7 | 4.6 | 4.6 | 4.5 | 4.4 | 4.2 | 4.1 | 4.5 | 4.7 | 4.9 |
| 0.8 | 5.5 | 5.6 | 5.6 | 5.5 | 5.3 | 5.0 | 4.9 | 5.4 | 5.6 |
| 0.9 | 6.5 | 6.6 | 6.7 | 6.7 | 6.5 | 6.2 | 5.9 | 5.8 | 5.7 |
| 1.0 | 7.5 | 7.7 | 7.8 | 7.9 | 7.8 | 7.5 | 7.1 | 6.8 | 6.7 |
| 1.1 | 8.6 | 8.8 | 9.0 | 9.1 | 9.1 | 8.9 | 8.6 | 8.1 | 7.8 |
| 1.2 | 9.7 | 10.0 | 10.2 | 10.4 | 10.4 | 10.3 | 10.0 | 9.6 | 9.2 |
| 1.3 | 10.8 | 11.2 | 11.5 | 11.7 | 11.8 | 11.7 | 11.5 | 11.2 | 10.8 |
| 1.4 | 12.0 | 12.4 | 12.8 | 13.1 | 13.2 | 13.2 | 13.1 | 12.8 | 12.4 |
| 1.5 | 13.2 | 13.7 | 14.1 | 14.5 | 14.7 | 14.7 | 14.6 | 14.4 | 14.1 |
| 1.6 | 14.5 | 15.0 | 15.5 | 15.9 | 16.2 | 16.3 | 16.3 | 16.1 | 15.8 |
| 1.7 | 15.8 | 16.4 | 16.9 | 17.4 | 17.7 | 17.9 | 17.9 | 17.8 | 17.6 |
| 1.8 | 17.1 | 17.8 | 18.4 | 18.9 | 19.3 | 19.5 | 19.6 | 19.6 | 19.4 |
| 1.9 | 18.5 | 19.2 | 19.9 | 20.4 | 20.9 | 21.2 | 21.4 | 21.4 | 21.3 |
| 2.0 | 19.9 | 20.7 | 21.4 | 22.0 | 22.6 | 22.9 | 23.1 | 23.2 | 23.2 |
| 2.1 | 21.4 | 22.2 | 23.0 | 23.7 | 24.3 | 24.7 | 25.0 | 25.1 | 25.1 |
| 2.2 | 22.9 | 23.8 | 24.6 | 25.4 | 26.0 | 26.5 | 26.8 | 27.0 | 27.0 |
| 2.3 | 24.4 | 25.4 | 26.3 | 27.1 | 27.8 | 28.3 | 28.7 | 29.0 | 29.1 |
| 2.4 | 26.0 | 27.0 | 28.0 | 28.8 | 29.6 | 30.2 | 30.7 | 31.0 | 31.1 |
| 2.5 | 27.6 | 28.7 | 239.7 | 30.6 | 31.5 | 32.1 | 32.6 | 33.0 | 33.2 |
| 2.6 | 29.3 | 30.4 | 31.5 | 32.5 | 33.4 | 34.1 | 34.7 | 35.1 | 35.3 |
| 2.7 | 31.0 | 32.2 | 33.3 | 34.3 | 35.3 | 36.1 | 36.7 | 37.2 | 37.5 |
| 2.8 | 32.7 | 34.0 | 35.2 | 36.3 | 37.3 | 38.1 | 38.8 | 39.3 | 39.7 |
| 2.9 | 34.5 | 35.8 | 37.1 | 38.2 | 39.4 | 40.2 | 41.0 | 41.5 | 41.9 |
| 3.0 | 36.3 | 37.7 | 39.0 | 40.2 | 41.4 | 42.3 | 43.1 | 43.8 | 44.2 |
| 3.1 | 38.2 | 39.6 | 41.0 | 42.2 | 43.5 | 44.5 | 45.4 | 46.1 | 46.6 |
| 3.2 | 40.1 | 41.6 | 43.0 | 44.3 | 45.7 | 46.7 | 47.6 | 48.4 | 48.9 |

## Culvert Pipe-Arch Embankment Areas <br> ( $\mathrm{Y}=$ Height to Widest Section of Pipe) <br> Equivalent Round Size

| Y | 24" | 30' | 36" | 42" | 48" | 54" | 60" | 66" | 72" |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 3.3 | 42.0 | 43.6 | 45.1 | 46.4 | 47.8 | 48.9 | 49.9 | 50.7 | 51.3 |
| 3.4 | 44.0 | 45.6 | 47.2 | 48.6 | 50.1 | 51.2 | 52.3 | 53.1 | 53.8 |
| 3.5 | 46.0 | 47.7 | 49.3 | 50.8 | 52.3 | 53.5 | 54.6 | 55.6 | 56.3 |
| 3.6 | 48.1 | 49.8 | 51.5 | 53.0 | 54.6 | 55.9 | 57.1 | 58.1 | 58.8 |
| 3.7 | 50.2 | 52.0 | 53.7 | 55.3 | 57.0 | 58.3 | 59.5 | 60.6 | 61.4 |
| 3.8 | 52.3 | 54.2 | 56.0 | 57.6 | 59.4 | 60.7 | 62.0 | 63.1 | 64.0 |
| 3.9 | 54.5 | 56.4 | 58.3 | 60.0 | 61.8 | 63.2 | 64.6 | 65.7 | 66.6 |
| 4.0 | 56.8 | 58.7 | 60.6 | 62.4 | 64.3 | 65.7 | 67.1 | 68.4 | 69.3 |
| 4.1 | 59.0 | 61.0 | 63.0 | 64.8 | 66.8 | 68.3 | 69.8 | 71.0 | 72.0 |
| 4.2 | 61.3 | 63.4 | 65.4 | 67.3 | 69.3 | 70.9 | 72.4 | 73.8 | 74.8 |
| 4.3 | 63.7 | 65.8 | 67.8 | 69.8 | 71.9 | 73.6 | 75.1 | 76.5 | 77.6 |
| 4.4 | 66.0 | 68.2 | 70.3 | 72.4 | 74.5 | 76.2 | 77.9 | 79.3 | 80.5 |
| 4.5 | 68.5 | 70.7 | 72.9 | 75.0 | 77.2 | 79.0 | 80.6 | 82.2 | 83.4 |
| 4.6 | 70.9 | 73.2 | 75.5 | 77.6 | 79.9 | 81.7 | 83.5 | 85.0 | 86.3 |
| 4.7 | 73.4 | 75.8 | 78.1 | 80.3 | 82.6 | 84.5 | 86.3 | 88.0 | 89.3 |
| 4.8 | 76.0 | 78.4 | 80.7 | 83.0 | 85.4 | 87.4 | 89.2 | 90.9 | 92.3 |
| 4.9 | 78.5 | 81.0 | 83.4 | 95.1 | 88.2 | 90.2 | 92.2 | 93.9 | 95.3 |
| 5.0 | 81.2 | 83.7 | 86.2 | 88.5 | 91.1 | 93.2 | 95.1 | 97.0 | 98.4 |

## Elliptical Culvert Pipe Embankment Areas <br> ( $\mathrm{Y}=$ Height to Center of Pipe) <br> Equivalent Round Size

| 0.1 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.2 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.0 | 0.9 |
| 0.3 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| 0.4 | 2.0 | 2.0 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| 0.5 | 2.6 | 2.6 | 2.6 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 0.6 | 3.3 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 |
| 0.7 | 4.0 | 4.0 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 |
| 0.8 | 4.9 | 4.8 | 4.7 | 4.7 | 4.7 | 4.6 | 4.6 | 4.6 | 4.6 |
| 0.9 | 5.9 | 5.7 | 5.6 | 5.5 | 5.5 | 5.4 | 5.4 | 5.4 | 5.4 |
| 1.0 | 6.9 | 8.7 | 6.5 | 6.4 | 6.4 | 6.3 | 6.3 | 6.2 | 6.2 |
| 1.1 | 8.0 | 7.8 | 7.5 | 7.4 | 7.3 | 7.2 | 7.2 | 7.1 | 7.1 |
| 1.2 | 9.1 | 9.0 | 8.6 | 8.4 | 8.3 | 8.2 | 8.2 | 8.1 | 8.1 |
| 1.3 | 10.3 | 10.2 | 5.9 | 9.5 | 9.4 | 9.3 | 9.2 | 9.1 | 9.1 |
| 1.4 | 11.5 | 11.5 | 11.2 | 10.8 | 10.6 | 10.4 | 10.3 | 10.2 | 10.1 |
| 1.5 | 12.7 | 12.8 | 12.6 | 12.2 | 11.9 | 11.6 | 11.5 | 11.4 | 11.3 |
| 1.6 | 14.0 | 14.1 | 14.0 | 13.7 | 13.3 | 12.9 | 12.7 | 12.6 | 12.5 |
| 1.7 | 15.3 | 15.5 | 15.4 | 15.2 | 14.9 | 14.3 | 14.1 | 13.9 | 13.7 |
| 1.8 | 16.6 | 16.9 | 16.9 | 16.7 | 16.3 | 15.9 | 15.5 | 15.2 | 15.1 |
| 1.9 | 18.0 | 18.3 | 18.4 | 18.3 | 18.1 | 17.6 | 17.0 | 18.7 | 16.5 |
| 2.0 | 19.4 | 19.8 | 19.9 | 19.9 | 19.8 | 19.4 | 18.7 | 18.2 | 18.0 |
| 2.1 | 20.9 | 21.4 | 21.5 | 21.6 | 21.5 | 21.1 | 20.6 | 19.9 | 19.6 |
| 2.2 | 22.4 | 23.0 | 23.2 | 23.3 | 23.3 | 23.0 | 22.5 | 21.7 | 21.2 |
| 2.3 | 24.0 | 24.6 | 24.8 | 25.0 | 25.1 | 24.8 | 24.4 | 23.7 | 23.0 |
| 2.4 | 25.6 | 26.2 | 26.0 | 26.8 | 26.9 | 26.7 | 26.4 | 25.7 | 24.9 |
| 2.5 | 27.2 | 27.9 | 28.3 | 28.6 | 28.8 | 28.7 | 28.4 | 27.9 | 27.1 |
| 2.6 | 28.9 | 29.7 | 30.1 | 30.5 | 30.7 | 30.7 | 30.4 | 29.9 | 29.2 |
| 2.7 | 30.6 | 31.4 | 31.9 | 32.4 | 32.7 | 32.7 | 32.5 | 32.1 | 31.5 |
| 2.8 | 32.3 | 33.3 | 33.8 | 34.3 | 34.7 | 34.8 | 34.7 | 34.3 | 33.7 |
| 2.9 | 34.1 | 35.1 | 35.7 | 36.3 | 36.7 | 36.9 | 36.8 | 36.5 | 36.0 |
| 3.0 | 35.9 | 37.0 | 37.7 | 38.3 | 38.8 | 39.0 | 39.1 | 38.8 | 38.4 |
| 3.1 | 37.8 | 38.9 | 39.7 | 40.4 | 40.9 | 41.2 | 41.3 | 41.1 | 40.7 |
| 3.2 | 39.7 | 40.9 | 41.7 | 42.5 | 43.1 | 43.6 | 43.6 | 43.4 | 43.2 |
| 3.3 | 41.7 | 42.9 | 43.8 | 44.6 | 45.3 | 45.7 | 45.9 | 45.8 | 45.6 |
| 3.4 | 43.7 | 45.0 | 45.9 | 46.8 | 47.5 | 38.0 | 48.3 | 48.2 | 48.1 |
| 3.5 | 45.7 | 47.1 | 48.1 | 49.0 | 49.8 | 50.4 | 50.7 | 50.7 | 50.6 |
| 3.6 | 47.8 | 49.2 | 50.3 | 51.3 | 52.1 | 52.7 | 53.2 | 53.2 | 53.2 |
| 3.7 | 49.9 | 51.4 | 52.5 | 53.6 | 54.5 | 55.2 | 55.7 | 55.8 | 55.8 |
| 3.8 | 52.0 | 53.6 | 54.8 | 55.9 | 56.9 | 57.6 | 58.2 | 58.4 | 58.5 |
| 3.9 | 54.2 | 55.9 | 57.1 | 58.3 | 59.3 | 60.1 | 60.8 | 61.0 | 61.2 |
| 4.0 | 56.4 | 58.2 | 59.4 | 60.8 | 61.8 | 62.7 | 63.4 | 63.7 | 63.9 |
| 4.1 | 58.7 | 60.5 | 61.8 | 63.2 | 64.3 | 65.3 | 66.0 | 66.4 | 66.7 |
| 4.2 | 61.0 | 62.9 | 64.3 | 65.7 | 66.9 | 67.9 | 68.7 | 69.1 | 69.5 |
| 4.3 | 63.4 | 65.3 | 66.7 | 68.3 | 69.5 | 70.6 | 71.8 | 71.9 | 72.4 |
| 4.4 | 65.8 | 67.8 | 69.3 | 70.8 | 72.1 | 73.3 | 74.2 | 74.8 | 75.3 |
| 4.5 | 68.2 | 70.3 | 71.8 | 73.5 | 74.8 | 76.0 | 77.1 | 77.6 | 76.2 |
| 4.6 | 70.7 | 72.8 | 74.4 | 76.1 | 77.5 | 78.8 | 79.9 | 80.5 | 81.2 |
| 4.7 | 73.2 | 75.4 | 77.0 | 78.8 | 80.3 | 81.6 | 82.8 | 83.5 | 84.2 |
| 4.8 | 75.7 | 78.0 | 79.7 | 81.6 | 83.1 | 84.5 | 85.7 | 86.5 | 87.3 |
| 4.9 | 78.3 | 80.6 | 82.4 | 86.3 | 85.9 | 87.4 | 89.7 | 89.5 | 90.4 |
| 5.0 | 80.9 | 83.3 | 85.2 | 87.2 | 88.8 | 90.4 | 91.7 | 92.6 | 93.5 |

Cu. Yds. of Concrete to be deducted from one Headwall because of skew.
Corrugated Pipe 8" Headwalls

| Size/Skew | 5" | 10" | 15" | 20" | 25" | 30" | 35" | 40" | 45" | 50" | 55" | 60" |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 18" Pipe | . 000 | . 001 | . 002 | . 003 | . 005 | . 007 | . 010 | . 013 | . 018 | . 024 | . 032 | . 044 |
| 24" Pipe | . 000 | . 001 | . 003 | . 005 | . 008 | . 012 | . 017 | . 024 | . 032 | . 043 | . 058 | . 078 |
| 30" Pipe | . 000 | . 002 | . 004 | . 008 | . 013 | . 019 | . 027 | . 037 | . 050 | . 067 | . 090 | . 121 |
| 30" Pipe | . 001 | . 003 | . 006 | . 011 | . 018 | . 027 | . 039 | . 053 | . 072 | . 097 | . 130 | . 174 |
| 42" Pipe | . 001 | . 004 | . 008 | . 015 | . 025 | . 037 | . 052 | . 073 | . 098 | . 132 | . 177 | . 238 |
| 48" Pipe | . 001 | . 005 | . 011 | . 020 | . 032 | `. 048 | . 068 | . 095 | . 128 | . 172 | . 231 | . 310 |
| 54" Pipe | . 001 | . 006 | . 014 | . 025 | . 041 | . 061 | . 087 | . 120 | . 163 | . 218 | . 292 | . 393 |
| 60" Pipe | . 002 | . 007 | . 017 | . 031 | . 050 | . 075 | . 107 | . 148 | . 201 | . 269 | . 360 | . 485 |
| 72" Pipe | . 003 | . 011 | . 025 | . 045 | . 072 | . 108 | . 154 | . 213 | . 289 | . 388 | . 519 | . 698 |
| 84" Pipe | . 004 | . 015 | . 034 | . 061 | .. 098 | . 147 | . 210 | . 290 | . 394 | . 528 | . 706 | . 950 |

Corrugated Pipe 6" Headwalls

| Size/Skew | 5" | 10" | 15" | 20" | 25" | 30" | 35" | 40" | 45" | 50" | 55" | 60" |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 18" Pipe | . 000 | . 001 | . 001 | . 002 | . 003 | . 005 | . 007 | . 010 | . 014 | . 018 | . 024 | . 033 |
| 24" Pipe | . 000 | . 001 | . 002 | . 004 | . 006 | . 009 | . 013 | . 018 | . 024 | . 052 | . 043 | . 058 |
| 30" Pipe | . 000 | . 001 | . 003 | . 006 | . 009 | . 014 | . 020 | . 028 | . 038 | . 051 | . 068 | . 091 |
| 36" Pipe | . 001 | . 002 | . 005 | . 008 | . 014 | . 020 | . 029 | . 040 | . 054 | . 073 | . 097 | . 131 |
| 42" Pipe | . 001 | . 003 | . 006 | . 011 | . 018 | . 028 | . 039 | . 054 | . 074 | . 99 | . 132 | . 178 |
| 48" Pipe | . 001 | . 004 | . 008 | . 015 | . 024 | . 036 | . 051 | . 071 | . 096 | . 129 | . 173 | . 233 |
| 54" Pipe | . 001 | . 005 | . 010 | . 019 | . 030 | . 046 | . 065 | . 090 | . 122 | `. 164 | . 219 | . 294 |
| 60" Pipe | . 001 | . 006 | . 013 | . 023 | . 038 | . 056 | . 080 | . 111 | . 151 | . 202 | . 270 | . 364 |
| 72" Pipe | . 002 | . 008 | . 018 | . 034 | . 054 | . 081 | . 116 | . 160 | . 217 | . 291 | . 389 | . 523 |
| 84" Pipe | . 003 | . 011 | . 025 | . 046 | . 074 | . 110 | . 157 | . 218 | . 295 | . 398 | . 530 | . 713 |

Concrete Pipe 8" Headwalls

| Size | T | 5" | 10" | 15" | 20" | 25" | 30" | 35" | 40" | 45" | 50" | 55" | 60" |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 18" Pipe | 21/2 | . 000 | . 001 | . 003 | . 005 | . 007 | . 011 | . 016 | . 022 | . 030 | . 040 | . 053 | . 071 |
| 24" Pipe | 23/4 | . 000 | . 002 | . 004 | . 008 | . 012 | . 018 | . 026 | . 036 | . 049 | . 065 | . 087 | . 117 |
| 30" Pipe | 3 | . 001 | . 003 | . 006 | . 011 | . 018 | . 027 | . 039 | . 053 | . 072 | . 097 | . 130 | . 174 |
| 36" Pipe | $31 / 2$ | . 001 | . 004 | . 009 | . 016 | . 026 | . 039 | . 055 | . 076 | . 103 | . 138 | . 185 | . 249 |
| 42" Pipe | $41 / 4$ | . 001 | . 005 | . 012 | . 022 | . 035 | . 053 | . 076 | . 105 | . 142 | . 191 | . 255 | . 343 |
| 48" Pipe | 5 | . 002 | . 007 | . 016 | . 029 | . 047 | . 070 | . 100 | . 138 | . 188 | . 252 | . 337 | . 453 |
| 54" Pipe | 5" | . 002 | . 009 | . 019 | . 035 | . 057 | . 085 | . 122 | . 168 | . 228 | . 306 | . 410 | . 551 |
| 54" Pipe | 51/2 | . 002 | . 009 | . 020 | . 037 | . 059 | . 088 | . 126 | . 14 | . 236 | . 316 | . 423 | . 569 |
| 60" Pipe | $51 / 2$ | . 003 | . 010 | . 024 | . 044 | . 070 | . 105 | . 150 | . 207 | . 281 | . 377 | . 505 | . 579 |
| 60" Pipe | 6 " | . 003 | . 011 | . 025 | . 045 | . 072 | . 108 | . 154 | . 213 | . 289 | . 388 | . 519 | . 698 |
| 72 " Pipe | 7" | . 004 | . 015 | . 035 | . 064 | . 130 | . 154 | . 220 | . 304 | . 412 | . 553 | . 740 | . 996 |
| 84" Pipe | 8" | . 005 | . 021 | . 048 | . 086 | . 139 | . 208 | . 297 | . 411 | . 558 | . 748 | 1001 | 1346 |

## Concrete Pipe 6" Headwalls

| Size | T | 5" | 10" | 15" | 20" | 25" | 30" | 35" | 40" | 45" | 50" | 55" | 60" |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 18" Pipe | 2112 | . 000 | . 001 | . 002 | . 003 | . 005 | . 008 | . 012 | . 016 | . 022 | . 030 | . 040 | . 053 |
| 24" Pipe | 21/4 | . 000 | . 001 | . 003 | . 006 | . 009 | . 014 | . 019 | . 027 | . 036 | . 049 | . 065 | . 088 |
| 30" Pipe | 3 " | . 001 | . 002 | . 005 | . 008 | . 014 | . 020 | . 029 | . 040 | . 054 | . 073 | . 097 | . 131 |
| 36" Pipe | 3112 | . 001 | . 003 | . 007 | . 012 | . 019 | . 029 | . 041 | . 057 | . 077 | . 104 | . 139 | . 187 |
| 42" Pipe | $41 / 4$ | . 001 | . 004 | . 009 | . 017 | . 027 | . 040 | . 057 | . 079 | . 107 | . 143 | . 191 | . 258 |
| 48" Pipe | 5 " | . 001 | . 005 | . 012 | . 022 | . 035 | . 053 | . 075 | . 104 | . 141 | . 189 | . 253 | . 340 |
| 54" Pipe | 5 " | . 002 | . 006 | . 015 | . 027 | . 043 | . 064 | . 091 | . 126 | . 171 | . 230 | . 307 | . 414 |
| 54" Pipe | 51⁄2 | . 002 | . 007 | . 015 | . 027 | . 044 | . 055 | . 094 | . 130 | . 177 | . 237 | . 317 | . 427 |
| 60" Pipe | 51⁄2 | . 002 | . 008 | . 018 | . 033 | . 053 | . 079 | . 112 | . 155 | . 211 | . 283 | . 378 | . 509 |
| 60" Pipe | 6 " | . 002 | . 008 | . 018 | . 034 | . 054 | . 081 | . 116 | . 160 | . 217 | . 291 | . 389 | . 523 |
| 72" Pipe | 7 " | . 003 | . 012 | . 026 | . 048 | . 077 | . 116 | . 165 | . 228 | . 309 | . 415 | . 555 | . 747 |
| 84" Pipe | 8" | . 004 | . 016 | . 036 | . 065 | . 104 | . 156 | . 223 | . 308 | . 418 | . 561 | . 751 | 1.010 |

