

✓ 9-14-06

## VARIANCE REQUEST

### Iowa Department of Natural Resources

1. Date: September 3, 2002	13. Decision: <i>Approved</i>
2. Review Engineer: Boris Eliosov	Date: <i>9/11/02</i>
3. Date Received: August 20, 2002	
4. Facility Name: Polk City	14. Appeal:
5. County Number: 77 (Polk)	Date:
6. Program Area: CP (Wastewater Construction)	
7. Facility Type: C05 (Biological Treatment)	
8. Subject Area: 355, Directional Boring, Pipe Material	
9. Rule Reference: 567-64.2(9)a	
10. Design Stds Ref: 12.4 (Materials); 12.6 (Details of Construction)	
11. Consulting Engr: Snyder & Associates	
12. Variance Rule: 567-64.2(9)c	

#### 15. Description of Variance Request:

The City of Polk City and its consulting engineer are requesting a variance from Design Standard 12.4, Materials and 12.6, Details of Construction for Sanitary Sewers. This standard describes the requirements for installation of flexible pipe sanitary sewer using open-cut methods including requirements for excavation, pipe bedding, and installation based on ASTM D 2321. The proposed method is horizontal directional drilling (HDD) using SDR 11 High Density Polyethylene (HDPE) pipe. This is a trenchless method of installing sanitary sewer that is not covered by the IA standards.

#### 16. Consulting Engineer's Justifications

Regarding HDD installation: Potential cost savings, equivalent effectiveness.

Regarding HDPE pipe: Using HDPE pipe is a common practice when installed by HDD. SDR 11 HDPE is substantially equivalent to the pipe materials described in Iowa Design Standards.

#### 17. Department's Justifications

##### **Recommend variance approval:**

Recommend variance approval for HDD installation. The proposed minimum slope of the sewer is 1.325 % that provides the velocity of 3.84 ft/s when flowing full. Depth and grade will be monitored using digital system providing 5% accuracy. Taking into account the vertical alignment tolerance with the check intervals of 50 feet, the slope of the flattest segment of the installed sewer can be 0.86% providing full flow velocity of 3.09 ft/s. It can be concluded therefore, that the proposed slopes are sufficient to meet or exceed the minimum full flow velocity of 2 ft/s required by Iowa Design Standards.

Recommend variance approval for SDR 9 HDPE. When exposed to the same loading, HDPE pipe installed by HDD will provide the same deflection as an open-cut installed SDR 35 PVC pipe over a period of 50 years (see attached calculations).

#### 18. Precedents Used

Williamson WWTF – Approved 2/6/01 (PVC SDR 21)

Avery WWTF – Approved 6/24/97 (PVC SDR 26)

Fontanelle WWTF – Approved 7/25/00 (HDPE SDR 9 & 11)

Marshalltown WWTF – Approved 11/05/98 (HDPE)

19. Staff Reviewer: *BE Eliosov* Date: *09/05/2002*

20. Supervisor: *Don Jensen* Date: *9/5/02*

21. Authorized by: *J Riessen* Date: *9/11/02*

### Minimum SDR for HDPE Directional Bore

When exposed to the same loading, HDPE pipe installed by HDD should provide the same deflection as an open-cut installed SDR 35 PVC pipe over a period of 50 years (a planning period of 50 years is required by Iowa Design Standards, Chapter 12, item 12.2).

1. **Open-cut installed PVC.** The Iowa Wastewater Facilities Design Standards require a minimum SDR for open-cut installed PVC sewer of 35 (IA 12.4.b) using bedding classes I, II, or III as described in ASTM D2321 (IA 12.6.2.2).

Deflection for open-cut installation is given by the Modified Iowa Equation:

$$\frac{\Delta}{D} = \frac{D_L K P}{[2E/(3(DR-1)^3) + 0.061E']} \quad (1)$$

where  $D_L$  = deflection lag factor = 1.0

$K$  = bedding constant = 0.1 typical (Uni-Bell PVC Pipe Handbook)

$P$  = earth pressure

$E$  = pipe modulus of elasticity

$E'$  = modulus of soil reaction based on pipe bedding material

Modulus of soil reaction:

Depending on bedding material, the value of  $E'$  can vary in a range from 0 to 3000. A course-grained soil bedding material with fines (equivalent to Class III – the least desirable bedding material allowed by IA Standards and suitable only for bedding material under dry trench conditions per ASTM D 2321) compacted slightly (less than 85% proctor density) has an  $E'$  value of 400 (Table 7.3, Uni-Bell Handbook of PVC Pipe).

Pipe modulus of elasticity:

Based on the data of US Army Corps of Engineers, 50-year  $E$  value for PVC is 140,000 psi (see attached Table).

### **2. HDD installed HDPE**

Deflection for directional bore installation is approximated by the following equation given in ASTM F 1962 and the Plexco Directional Drilling Technical Note:

$$\frac{\Delta}{D} = \frac{0.0125 \times P}{\frac{E}{12(DR-1)^3}} \quad (2)$$

HDPE modulus of elasticity:

Based on the data of US Army Corps of Engineers, 50-year  $E$  value for HDPE is 22,000 psi (see attached Table).

If DR 35 is used in Equation 1, Equation 2 will yield the same deflection value with DR of 9.15. It can be concluded therefore, that SDR 9 HDPE pipe is required to provide deflection similar to open-cut installed SDR 35 PVC pipe.



**Table 6-2**  
**Mechanical Properties for Plastic Pipe Design**

Type of Pipe	Initial Minimum Tensile Strength MPa (psi)	Initial Minimum Modulus of Elasticity MPa (psi)	Standard Cell Class	50-Year Minimum Tensile Strength MPa (psi)	50-Year Minimum Modulus of Elasticity MPa (psi)	Strain Limit Percent (%)	Pipe Stiffness kPa (psi)
Smooth Wall, PE	20.7 (3,000)	758 (110,000)	ASTM D 3350, 335434C ASTM F 714	9.93 (1,440)	152 (22,000)	5	Varies
Corrugated PE	20.7 (3,000)	758 (110,000)	ASTM D 3350, 335412C AASHTO M 294	6.21 (900)	152 (22,000)	5	Varies
Ribbed, PE	20.7 (3,000)	758 (110,000)	ASTM D 3350, 335434C AASHTO M 278 ASTM F 679	9.93 (1,440)	152 (22,000)	5	320 (46)
Ribbed, PE	20.7 (3,000)	758 (110,000)	ASTM D 3350, 335434C AASHTO M 278 ASTM F 679	9.93 (1,440)	152 (22,000)	5	320 (46)
Smooth Wall, PVC	48.3 (7,000)	2,758 (400,000)	ASTM D 1754, 12454C AASHTO M 278 ASTM F 679	25.51 (3,700)	965 (140,400)	5	320 (46)
Smooth Wall, PVC	41.4 (6,000)	3,034 (440,000)	ASTM D 1784, 12364C ASTM F 679	17.93 (2,600)	1,092 (158,400)	3.5	320 (46)
Ribbed, PVC	41.4 (6,000)	3,034 (440,000)	ASTM D 1784, 12454C ASTM F 794	17.93 (2,600)	1,092 (158,400)	3.5	70 (10) 320 (46)
Ribbed, PVC	48.3 (7,000)	2,758 (400,000)	ASTM D 1784, 12454C ASTM F 794 & ASTM F 949	25.51 (3,700)	965 (140,000)	5	348 (50)
PVC Composite	48.3 (7,000)	2,758 (400,000)	ASTM D 1784, 12454C ASTM D 2680	25.51 (3,700)	965 (140,000)	5	1,380 (200)

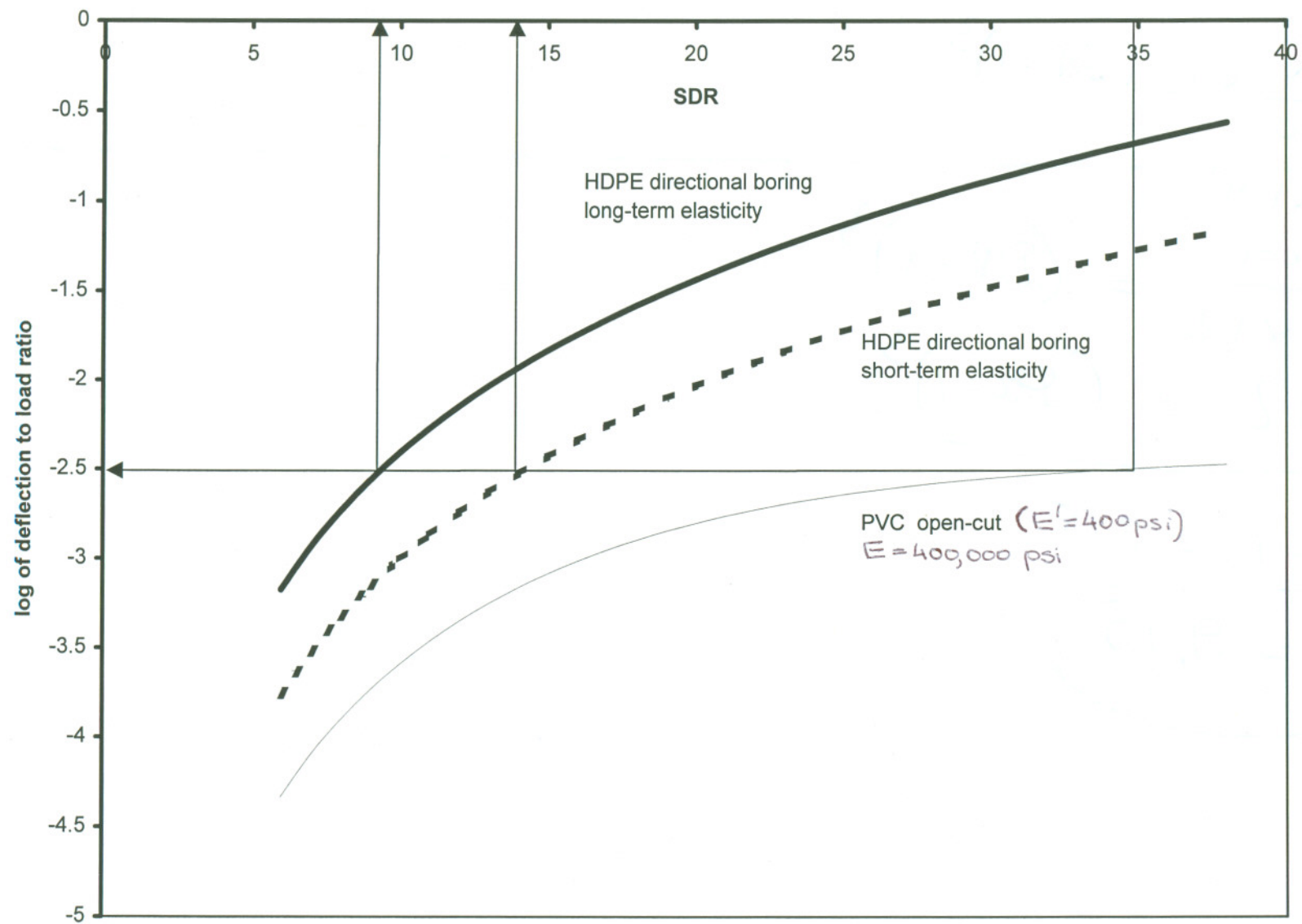
during service. When used, these materials must be approved by the geotechnical engineer.

*b. Pipe envelope.* The pipe envelope and bedding and backfill terms are illustrated in Figure 6-1.

*c. Seepage control.* When seepage along the pipeline is a consideration, a drainage fill detail is required as discussed in paragraph 1-6.e. If flowable concrete, CLSM, or other such materials are used, note that these materials do not adhere to plastics and will not control seepage unless a sufficient number of rubber water stops (gaskets) are used. Piping systems intended for sanitary sewer applications offer water stop gaskets that seal to the outer pipe wall and bond to concrete.

*d. Subdrainage applications.* For this application, open grade, nonplastic granular backfill materials compacted to 90 percent relative density in accordance with ASTM D 4254 and D 4253 will be used to fill the pipe zone above the invert. Granular backfill should be wrapped in a suitable geotextile to prevent the migration of soil fines into the granular material.

*e. Foundation.* Foundation is the in situ material struck to grade or the trench bottom below the pipe and its bedding layer. The foundation supports the pipe and maintains its grade. Plastic pipes, due to their viscoelastic properties, do not provide the necessary long-term beam strength to bridge soft spots or settlement of the foundation. The foundation must carry the fill loads with



Records

STATE OF IOWA  
DEPARTMENT OF NATURAL RESOURCES  
HENRY A. WALLACE BUILDING  
DES MOINES, IOWA 50319

CONSTRUCTION PERMIT

City of Polk City  
P.O. Box 426  
Polk City, IA 50226

Permit No.: 2002-330S  
File: Polk City-- Sewage 6-77-70-0-01  
Re: Northeast Sanitary Sewer, Water,  
and Street Improvement Project  
Project No.: S2002-320

In accordance with the provisions of Section 455B.173.3 and 455B.174.4, Code of Iowa, and Rule 567--64.2(455B) or Rule 567--65.6(455B), or Rule 567--43.3(455B) of the Iowa Administrative Code, the Director of the Department of Natural Resources does hereby issue a permit for the construction of:

2,838 feet of 8-inch sanitary sewer and appurtenances; Northeast Sanitary Sewer, Water, and Street Improvement Project, Polk City, IA.

The construction of the project shall be initiated within one year of issuance of this permit or this permit is no longer valid. Within thirty days after completion of construction, the permit holder shall submit a certification by a licensed professional engineer that the project was completed in accordance with the approved project documents.

Pursuant to Section 455B.174.4, Code of Iowa, you have the right to appeal any condition of this permit by filing with the Director of the Department of Natural Resources a notice of appeal and request for administrative hearing within thirty days of receipt of this permit.

Contact Boris Eliosov at 515/281-7953 with any questions or comments.

For the Department of Natural Resources:

Jeffrey R. Vonk, Director

By   
ENVIRONMENTAL PROTECTION DIVISION

Date: June 12, 2002

cc: Snyder and Associates, Inc.  
Field office

Plan and Specifications Distribution

[1] Applicant; [1] Engineer; [1] DNR





# STATE OF IOWA

THOMAS J. VILSACK, GOVERNOR  
SALLY J. PEDERSON, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES  
JEFFREY R. VONK, DIRECTOR

September 6, 2002

Mike Sparks, City Administrator  
P.O. Box 426  
Polk City, IA 50226-0426

RE: Request for variance. Northeast Sanitary Sewer, Water, and Street Improvement Project, Polk City, IA.  
DNR 6-77-70-0-01

Dear Mr. Sparks

The Iowa Department of Natural Resources has considered the variance request to use SDR 11 high-density polyethylene (HDPE) pipe installed by horizontal directional drilling (HDD). According to 567 IAC 64.2(9), it was determined that the variance consideration was warranted. It was also determined that the variance should be reviewed based on the subparagraph "e"(1) (utilization of new equipment or new process technology that is not explicitly covered by the current design standards) that requires the requested variance to provide substantially equivalent or improved effectiveness. The relative effectiveness of the proposed technology was evaluated by comparing long term deflection of HDPE pipe installed using HDD with standard installation (open-cut installed SDR 35 PVC pipe). Long term deflection values similar to standard installation (i.e., substantial equivalency) were obtained for SDR 9 HDPE pipe (see attached calculations).

Based on the above considerations, the variance request has been approved subject to the following conditions:

- The HDPE pipe shall have a wall thickness equivalent to SDR 9 or thicker.
- According to state rule 567 IAC 60.4(1), the City must submit to the Department a change order. A supplemental written approval will be issued when the changes submitted by the applicant meet department requirements. Construction of the project revisions shall not proceed until changes have been approved.

If you have any questions, please contact Boris Eliosov at 515/281-7953. My telephone number is 515-281-5029.

Sincerely,

A handwritten signature in black ink, appearing to read "Jack Riessen".

for Jack Riessen, Chief  
Water Quality Bureau

cc.: Snyder & Associates  
Field Office #5