

APPENDIX C
TECHNICAL SPECIFICATIONS

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF MINES AND
MINERAL INDUSTRIES
HARRISBURG, PENNSYLVANIA

REVISED
TECHNICAL SPECIFICATIONS
ERNEST MINE COMPLEX
ERNEST, PENNSYLVANIA
PROJECT NO. SL-107-4

E. D'APPOLONIA
CONSULTING ENGINEERS, INC.
PITTSBURGH, PENNSYLVANIA

MAY 1970

TABLE OF CONTENTS

	PageNo.
SUGGESTED FORM OF PROPOSAL BID	P-1
SPECIAL PROVISIONS	
1.01 Purpose of the Work	1
1.02 Scope of Work	1
1.03 Requirements for Health and Safety	3
1.04 Cross-Section Surveys and Layout	3
1.05 General	3
1.06 Utility Protection	5
1.07 Water Supply	5
1.08 Control Supervision by Engineer	5
1.09 Changes	5
1.10 Existing Structures	6
1.11 Access and Temporary Roads	6
TECHNICAL PROVISIONS	
2.01 Excavation	7
2.02 Compaction	10
2.03 Backfill	11
2.04 Rock Surfaces	12
2.05 Concrete and Concrete Work	13
2.06 Accessories	14
2.07 Tests	15
2.08 Formwork	15
2.09 Reinforcement	16
2.10 Damp proofing Under Slabs on Grade	16
2.11 Embedded Metal	17
2.12 Preparation of Equipment and Place of Deposit	17
2.13 Mixing of Concrete	17
2.14 Conveying	17
2.15 Concrete Placement	17
2.16 Construction Joints	19
2.17 Curing	19
2.18 Acid Resistant Coating	19
2.19 Topsoil	20
2.20 Seeding	20
2.21 Galvanized Chain Link Fence	21
2.22 Demolition of Existing Structures	22
2.23 Valves and Valve Housings	22

TABLE OF CONTENTS (Cont'd)

	Page No.
2.24 Pipe Encasements and Insulation	23
2.25 Piping Between E-1 and E-2 Mine Openings	23
2.26 Mine Barrier Access Gates	23
2.27 E-3 Wood Barrier	24
2.28 Packers & Plugging	24
2.29 Calipering or Section Gauging	25
2.30 Remove Existing Mine Barrier	26
2.31 Exploratory Excavation	26
 INSTRUMENTATION AND DRILLING	
3.01 Instrumentation and Drilling	27
3.02 Boring Logs and Caliper Logs	34

For all work pertaining to the ERNEST MINE WATER ABATEMENT SYSTEM the sum of

(\$ _____)

This amount is hereby designated as Base Proposal.

Pay Item	Description	Unit	Estimated Quantities	Unit Cost (\$)	Total Cost (\$)	Unit Cost	
						Add \$/Unit	Deduct \$/Unit
A	CUMMINGS SHAFT						
	(1) Dewatering (sump pumping)	L.S.	L.S.				
	(2) Remove existing fence and portion of front wall	L.S.	L.S.				
	(3) Excavation:						
	a) Soil	cu.yd.	600				
	b) Rock	cu.yd.	100				
	(4) Furnish and install reinforced concrete structure	cu.yd.	60				
(5) Furnish and install pipe, valve and valve housing	L.S.	L.S.					
(6) Furnish and install wire fence and gate	L.S.	L.S.					
(7) Backfill	cu.yd.	700					

Pay Item	Description	Unit	Estimated Quantities	Unit Cost (\$)	Total Cost (\$)	Unit Cost	
						Add \$/Unit	Deduct \$/Unit
B MINE OPENING E-1 BARRIER	(1) Preparation	L.S.	L.S.	—		—	—
	(2) Excavation a) Rock	cu.yd.	4				
	(3) Overhaul	cu.yd.	—				
	(4) Furnish and install rein- forced concrete structure	cu.yd.	4				
	(5) Furnish and install access gate	L.S.	1 each				
MINE OPENING E-2 BARRIER	(1) Preparation (Includes Dewatering)	L.S.	L.S.	—		—	—
	(2) Demolition of pump housing and concrete beam	L.S.	L.S.	—		—	—
	(3) Excavation a) Rock	cu.yd.	4				
	(4) Furnish and install rein- forced concrete structure	cu.yd.	4				
	(5) Furnish and install access gate	L.S.	1 each				

Pay Item	Description	Unit	Estimated Quantities	Unit Cost (\$)	Total Cost (\$)	Unit Cost	
						Add \$/Unit	Deduct \$/Unit
C	WATER TRANSFER PIPE BETWEEN E-1 and E-2 MINE OPENINGS						
	(1) Excavation	cu.yd.	350				
	a) Soil	cu.yd.	—				
	(2) Overhaul	cu.yd.	—				
	(3) Remove portion of existing bridge	L.S.	L.S.				
	(4) Furnish and place pipe bed- ding material	cu.yd.	70				
	(5) Furnish and install pipe	L.F.	500				
(6) Furnish and install pipe support, en- casements and insulation	L.F.	35					
a) Bridge por- tion	L.F.	300					
b) Trenched portion	cu.yd.	300					
(7) Backfill	cu.yd.	300					

Pay Item	Description	Unit	Estimated Quantities	Unit Cost (\$)	Total Cost (\$)	Unit Cost	
						Add \$/Unit	Deduct \$/Unit
D MINE OPENING E-3 BARRIER	(1) Preparation	L.S.	L.S.	—		—	—
	(2) Excavation a) Rock	cu.yd.	4				
	(3) Furnish and install rein- forced concrete structure	cu.yd.	4				
	(4) Furnish and install access gate	L.S.	1 each			—	—
	(5) Replace exist- ing wood barrier- cade	L.S.	L.S.			—	—
E-3 COLLAPSED SHAFT-PERMANENT SEAL	(1) Preparation (Includes De-watering)	L.S.	L.S.	—		—	—
	(2) Excavation a) Soil	cu.yd.	200				
	b) Rock	cu.yd.	200				
	(3) Overhaul	cu.yd.	—			—	—
	(4) Furnish and install rein- forced concrete structure	cu.yd.	6.5				
(5) Backfill	cu.yd.	400					

Pay Item	Description	Unit	Estimated Quantities	Unit Cost (\$)	Total Cost (\$)	Unit Cost	
						Add \$/Unit	Deduct \$/Unit
E	E-4 BOREHOLES	(1) Granular Fill	50				
	(a) Borehole No. 1 approx. 8" dia., 90' deep	(1) Cleaning	90				
		(2) Plug and Grout	L.S.				
	(b) Borehole No. 2 approx. 16" dia., 90' deep	(1) Cleaning	90				
		(2) Plug, grout and install PVC pipe and valve	L.S.	L.S.			
		(3) Furnish and install reinforced concrete pad and valve block	cu.yd.	2			
		(4) Furnish and install valve housing	L.S.	L.S.			
	(c) Borehole No. 3 approx. 8" dia., 90' deep (exact location not known)	(1) Reaming	L.F.	90			
		(2) Plug and grout	L.S.	L.S.			

Pay Item	Description	Unit	Estimated Quantities	Unit Cost (\$)	Total Cost (\$)	Unit Cost	
						Add \$/Unit	Deduct \$/Unit
E	(d) Borehole No. 4 approx. 8" dia., 90' deep	L.F.	90				
		L.S.	L.S.				
F	BOREHOLE IN CREEKSIDE DDH No. 44	Cost Plus	Percent				
		L.S.	L.S.				
		L.S.	L.S.				
		L.F.	120				
		L.S.	L.S.				
G	BOREHOLE ADJACENT TO CROOKED CREEK	Cost Plus	Percent				
		L.S.	L.S.				
		L.S.	L.S.				
		L.F.	100				
		L.S.	L.S.				

Pay Item	Description	Unit	Estimated Quantities	Unit Cost (\$)	Total Cost (\$)	Unit Cost	
						Add \$/Unit	Deduct \$/Unit
H	FULTON SHAFTS SEALING						
	(a) Fulton Shaft A						
	(1) Excavation - (includes removing existing walls) a) Soil	cu.yd.	3600				
	(2) Overhaul	cu.yd.	--				
	(3) Preparation	L.S.	L.S.				
	(4) Furnish and install reinforced concrete seal (includes decking)	cu.yd.	25				
	(5) Backfill (includes backfill in shaft below seal)	cu.yd.	4000				

Pay Item	Description	Unit		Estimated Quantities	Unit Cost (\$)	Total Cost (\$)	Unit Cost	
		Cost Plus	Percent				Add \$/Unit	Deduct \$/Unit
H	(b) Fulton Shaft B (assumes similar configuration to Fulton A. Quantities are for one shaft - a second shaft may require sealing)	(1) Exploratory excavation	cu. yd.	3600	-----	-----	-----	-----
		(2) Excavation	cu. yd.	-----	-----	-----	-----	-----
		(3) Overhaul	L.S.	L.S.	-----	-----	-----	-----
		(4) Preparation	cu. yd.	25	-----	-----	-----	-----
		(5) Furnish and install reinforced concrete seal (includes decking)	cu. yd.	4000	-----	-----	-----	-----
		(6) Backfill (includes required backfill in shaft below top of seal)	cu. yd.	-----	-----	-----	-----	-----
(c) Fulton Shaft B (possible third vertical shaft)	(1) Exploratory excavation	cu. yd.	3600	-----	-----	-----	-----	
		(2) Excavation	cu. yd.	-----	-----	-----	-----	
		(3) Overhaul	L.S.	L.S.	-----	-----	-----	-----
		(4) Preparation	cu. yd.	25	-----	-----	-----	-----
		(5) Furnish and install reinforced concrete seal (includes decking)	cu. yd.	4000	-----	-----	-----	-----
		(6) Backfill	cu. yd.	-----	-----	-----	-----	-----

Item	Description	Unit	Estimated Quantities	Unit Cost (\$)	Total Cost (\$)	Unit Cost	
						Add \$/Unit	Deduct \$/Unit
INSTRUMENTATION AND PRESSURE TESTING AT 11 LOCATIONS INCL. SURVEY LAYOUT	(1) Soil boring	L.F.	150				
	(2) NX Coring	L.F.	1000				
	(3) Pressure Testing	Hrs.	110				
	(4) Furnish and install standpipe including grout	L.F.	1100				
	(5) Mobilization/Rig	Each	2				
EXISTING MASONRY BARRIER INSIDE MINE E-1	(1) Investigation	Man Hrs.	40				
	(2) Removal	Cost Plus	Percent				

(Signed)

(Title)

SPECIAL PROVISIONS

1.01 PURPOSE OF THE WORK

The purpose of the following construction work is to direct mine water presently flowing from several locations of the Ernest Mine Complex to a more convenient and central location for treatment and return to Crooked Creek via McKee Run.

1.02 SCOPE OF WORK

It is the intent of these Plans and Specifications to detail the construction of the complete water diversion system to direct polluted mine water from the Ernest Mine Complex to a central treatment plant for the Department of Mines and Mineral Industries, Commonwealth of Pennsylvania. Construction of the treatment plant is not part of this contract.

The Scope of Work shall include, but is not necessarily limited to the items of work listed below. Locations of designated mine openings and shafts are shown on Drawing No. 68-108-EI.

- A. Enclosing the opening of the Cummings shaft and installing a valve for the purpose of increasing the water level elevation at the shaft to permit flow to occur at mine opening E-1. The valve shall remain open until all work is completed.
- B. Construct a reinforced concrete barrier at mine openings E-1 and E-2.
- C. Install a drainage pipe between mine openings E-1 and E-2 to transfer the mine acid water from the Cummings Mine Area north of mine opening E-1 to the Ernest Mine Area south of mine opening E-2.
- D. Seal one of two mine openings at E-3 and construct a reinforced concrete barrier at the other opening. The barrier shall be completed to the extent shown on the drawings. Future installation of a pipe will be made by others for transfer of the mine water to the treatment plant.
- E. At the E-4 work areas, hydraulically seal three boreholes and partially seal and install a valve at a fourth borehole. These boreholes are presently discharging acid mine water.

1.02 SCOPE OF WORK (Cont'd)

F. Investigate borehole DDH No. 44 shown on Drawing Nos. 68-108-E1 and 68-108-E2 located in the Borough of Creekside, in accordance with Section 2.32, Exploratory Excavation. If required, as directed by the engineer, caliper and completely seal the borehole as detailed in Sections 2.29 and 2.30.

G. Investigate the borehole shown on Drawing Nos. 68-108-E1 and 68-108-E2 located adjacent to Crooked Creek between the E-4 borehole and the Borough of Creekside, in accordance with Section 2.32, Exploratory Excavation. If required, as directed by the engineer, caliper and completely seal the borehole as detailed in Sections 2.29 and 2.30.

H. Seal Fulton Run Shaft A located in the town of Fulton Run. Investigate the location of one or two vertical shafts in the Fulton Run B Shaft area in accordance with Section 2.32, Exploratory Excavation. If the shaft or shafts are present, they must be sealed in accordance with the procedure followed for Fulton Run A Shaft.

I. Survey layout and drill eleven NX core boring holes at specified locations, pressure test the rock and install piezometers for the purpose of monitoring the water elevation in the mines after all enclosures are completed.

J. Investigate the present condition of an existing masonry barrier constructed within the mine shafts approximately 1,000 feet north of mine opening E-1 and remove the barrier.

K. Close all valves when the enclosures are completed.

The Work included under this Contract consists of furnishing all plant, labor, and materials; and performing all Work as required by the Contract, in strict accordance with the Contract Documents to include the Specifications and Drawings; and such detail drawings as may be furnished by the Engineer from time to time during construction in interpretation of said Drawings. The Work shall be complete, and all Work, materials and services not expressly called for in the Specifications, or specifically indicated on the Drawings, which will be necessary for complete and proper construction to carry out the Contract in good faith, shall be performed, furnished and installed by the Contractor. The Work shall be executed in the best and most workmanlike manner by qualified, careful and experienced workmen.

1.03 REQUIREMENTS FOR HEALTH AND SAFETY

The Contractor shall observe all federal, state and local laws and regulations pertaining to health and safety, handling of foodstuffs, water supply, sanitary facilities, waste disposal, etc. The Contractor shall conduct the work in a safe and practical manner.

The Contractor's and Engineer's personnel will not be permitted inside any mine opening unless accompanied by the Pennsylvania State Mine Inspector for the area. It shall be the Contractor's responsibility to arrange for the services of the Mine Inspector.

104 CROSS-SECTION SURVEYS AND LAYOUT

The Contractor shall provide the engineering required to determine cross-sections as hereinafter described and shall also provide the survey layout of the test borings specified in Item No. I, Section 1.02 Scope of Work. All surveys including crosssections will be under the direct supervision of a Registered Professional Engineer or Licensed Surveyor.

As indicated on the drawings, temporary bench marks have been established at the work areas and may be used by the Contractor.

1.05 GENERAL

The Contractor may establish headquarters and other necessary installations, such as tool_ room facilities, on the property . easements as designated on the drawings.

The means employed for doing the various classes of Work shall be at the option of the Contractor, subject to such suggestions or approval by the Engineer as may be necessary to safeguard the character and result of all features of the Work.

All Work shall be done in the order of progress required by the Engineer and to coordinate different classes of Work to the best advantage. The Contractor shall coordinate and join together all of the various subdivisions of the Work, and produce complete installations.

Other contractors may be engaged in construction activities on the project and the Contractor hereunder may be required to work in close proximity, and at times, in combined operations .with other contractors. The Contractor hereunder shall cooperate with all other contractors, coordinate his work with theirs, and arrange his activities so as not to unduly interfere or retard progress of work of the other contractors.

1.05 GENERAL (Cont'd)

All other Work completed or in progress, as well as machinery and equipment that may be damaged through the execution of the Work hereunder, shall be protected by the Contractor and such protection shall remain and be maintained until its removal is approved by the Engineer.

The Contractor's working areas shall be cleaned up by him on a day-to-day basis, with all rubbish removed from the site. At final completion of all Work, the Contractor shall leave the entire premises within the site of his operations clean and free from rubbish resulting from his construction operations.

Each Bidder shall acquaint himself by personal examination of the location of the proposed Work, and shall inform himself of the actual conditions and requirements of the Work, including risks, means of access, character of the soil and subsoil, restrictions and regulations. Failure to do so will not relieve a successful Bidder of his obligations to furnish all material and labor necessary to carry out the provisions of the Contract Documents and to complete the contemplated Work for the consideration set forth in his Bid.

The submission of a Bid shall constitute and imply full knowledge of such conditions and regulations and acceptance of the risks therein contained.

Where soil surveys and borings are indicated on the Drawings it is understood that they were made in the usual manner and with reasonable care, and their location, depths and the character of the material have been recorded in good faith. There is no expressed or implied agreement that the depths or the character of the material have been correctly indicated, and Bidders should take into account the possibility that conditions affecting the work to be done may differ from those indicated.

The Contractor is urged to make any additional borings he may consider necessary for proper evaluation of the Work to be performed.

When reference is made herein to Specifications or Standards of the American Society for Testing Materials (ASTM), American Concrete Institute (ACI), American Institute of Steel Construction (AISC), American Welding Society (AWS), American Standards Association (ASA), American Water Works Association (AWWA), or other Specifications or Standards, it shall be understood to refer to the latest issue or revision thereof.

1.06 UTILITY PROTECTION

Utility and drainage lines shall be marked for position and active lines shall remain adequately protected. The Contractor shall be responsible for the protection and maintenance of these lines. If existing underground sewer, gas or utility lines are damaged by construction equipment or subjected to damage caused by the proximity of such equipment, the Contractor shall bear the expense of replacing or repairing damaged underground sewer, gas or utility lines.

Protection of any power transmission lines and poles in the construction area shall be the responsibility of the Contractor and arrangements for their relocation, if required, shall be made by the Contractor with the appropriate power company. The Contractor shall assume all responsibility and liability for excavating in the vicinity of the poles.

1.07 WATER SUPPLY

Arrangements for water shall be made by the Contractor. All costs for water shall be borne by the Contractor at no additional cost to the Owner.

1.08 CONTROL SUPERVISION BY ENGINEER

The entire operation will be under the supervision and direction of the Engineer. The exact nature of the soils as they are disclosed will be evaluated by the Engineer and he shall make all final determinations as to classifications of materials and adequacy of earthwork performed on the site. The Engineer shall have the authority to direct the Contractor to remove unsatisfactory fills or underlying materials. In the event of changes which require the handling of more or less material than called for under the Contract Documents, the before-and-after cross-section method shall be used to determine the amount of material which is handled in addition to or not handled in deletion of the work required by the Contract Documents; this determination shall be conclusive and shall form the basis for additions to or subtractions on the basis of unit prices.

1.09 CHANGES

Changes will be made only after approval, in writing, by the Owner and Engineer.

1.10 EXISTING STRUCTURES

Existing structures including buildings, sidewalks, and curbs shall be maintained in their present condition throughout the progress of construction under this Contract unless shown otherwise on the Contract Drawings or directed otherwise by the Engineer. The Contractor shall use all precautions necessary to prevent damage or interruption of service of any utility and shall be responsible for any and all damage to existing, structures, utilities, etc., from operations under this Contract.

1.11 ACCESS AND TEMPORARY ROADS

Access to work areas shall be entirely within easement areas detailed on the drawings or on public roads. The Contractor shall construct and maintain temporary roads as necessary on easement areas for convenient access to the various parts of the Work, and to such portions of land as may be cut off and for other necessary purposes incidental to the performance of this contract, and he shall erect such temporary fences or guards as may be necessary to keep unauthorized persons away from the Work. Grading and surfacing of temporary road excavations, fills and embankments for purposes of construction, or for convenience, beyond the limits of ordered excavations and all temporary bridges, trestles, fences and guards, shall be provided by the Contractor and shall be maintained in good condition. The Contractor shall be required to maintain all roads used by his hauling equipment in a dust-free condition..

TECHNICAL PROVISION

2.01 EXCAVATION

A. GENERAL

The Work under this Section shall consist of completing all excavations for foundations, trenches and other excavations shown on the drawings and/or as directed by the Engineer. Excavations shall be done to lines and grade shown on the drawings and as specified. During excavation operations, material suitable for backfilling or filling shall be piled in an orderly manner, a sufficient distance from the banks of the excavations to avoid overloading, and to prevent slides or cave-ins.

Clean excavated material suitable for filling shall be deposited on the site as required to bring low areas to the required subgrades. Any additional excavated material, shall be stockpiled on the site or removed to a location off the site, as directed by the Engineer. Off site locations for disposal shall be no more than two miles from the area of work. Additional compensation shall be made for hauls greater than two miles at the bid price for overhaul per cubic yard.

B. EARTH EXCAVATION

Earth excavation shall include the satisfactory removal and disposal of all clay, loam, sand, gravel, shale, slate, hardpan, loose stones in masses, and all boulders measuring less than one and one-half cubic yard (1-1/2) in volume.

All earth excavation and stockpiling shall be done with reasonable neatness, and excavated materials shall not be carelessly strewn over the premises. Re-excavating materials from storage piles and any other rehandling shall be included as part of the Work. Materials unsuitable for use in the permanent Work shall be disposed of as indicated above. The Contractor shall be responsible for placing material in an orderly manner within the disposal limits designated. The surface of the dump shall be neatly graded to blend with the natural contours of the existing ground, and to provide for puddle-free drainage. Material over areas of structural excavation shall be left undisturbed for a distance of at least two feet above the top of structural excavation limits until structural excavation is ready to be started.

C. ROCK EXCAVATIONS

Rock excavation is classified as excavation of aggregate conglomerate deposits that are so firmly cemented, bonded or held together as to possess the characteristics of massive solid rock, rock material in ledges, boulders measuring more than one and

2.01 EXCAVATION (Cont'd)

one-half (1-1/2) cubic yard in volume and material other than boulders that can be penetrated only 3 inches with 60 blows of a split barrel sampler being struck with a 140 pound hammer falling 30 inches in accordance with ASTM designation D1586-67, but not hard and compact material such as cemented gravel, glacial till, stiff residual soils and relatively soft weathered and decomposed rock that can be removed without continuous and systematic drilling and blasting.

During field operations the Engineer's interpretation of rock excavation and earth shall govern. However, if the Contractor disputes the Engineer's interpretation of rock excavation in relation to the specifications, the Contractor shall test the material in place at his own cost in accordance with ASTM designation D1586-67 in the presence of the Engineer and the above definitions shall apply.

If rock excavation by blasting is necessary, it shall be done by a carefully planned and executed program of controlled blasting. Blasting shall be done with explosives of such quantity and power and fired in such sequence and locations as not to injure personnel, damage or crack rock against which concrete will be placed, or damage property or adjacent Work. Blasting shall be performed by skilled operators in accordance with state and local ordinances.

Over excavation in rock shall be backfilled to the plan lines with fill concrete at the Contractor's expense. Fill concrete shall have a 28-day strength of at least 2000 pounds per square inch.

D. STRUCTURAL EXCAVATION

All foundation excavations, and foundation bases shall be excavated or built to the depths shown on the Drawings or to such other depths that the Engineer, as the Work progresses, may decide are necessary. The Contractor shall accept the contingencies of greater or lesser depths and of changes in dimensions or other features of construction which they may involve, all without modification of the unit prices fixed by the Contract.

The Contractor shall make all excavation of every nature in whatever materials may be encountered and do all Work necessary to build the foundation to required depths, including all pumping, bailing or other dewatering and the removal of all timbers, piling, logs, boulders, portions of old structures,

2.01 EXCAVATION (Cont'd)

rip rap, or other obstacles which may be encountered. No shooting or blasting shall be carried on without special written approval by the Engineer. Shooting and blasting shall be executed in a manner suitable to the conditions and as permitted by authorities having jurisdiction, with minimum feasible explosive charges, and by skilled operators.

All open excavations for foundations shall be made in such manner that the permanent structure may be properly constructed without reduction of the concrete dimensions shown by the Drawings and to the depths which may be required. Rounded or undercut corners and edges of foundation bases will not be permitted.

The Contractor shall preserve the stability of the earth which supports, the concrete structures by protecting it from excessive disturbance from moisture or other means. To this end, at least two (2) feet of earth cover shall be left in place over the foundation material and not removed until just prior to beginning structural work.

If unsuitable material is discovered at the founding elevations, the unsuitable material shall be excavated to the limits required by the Engineer. Backfill material for unsuitable material shall be as specified hereinafter or as approved by the Engineer. Over excavation and backfill shall be at the direction of the Engineer only. Over excavation and backfill which was not directed by the Engineer will be at the Contractor's own expense.

E. SHEETING INSTALLATIONS

The Engineer may require Drawings for approval in particular, temporary sheeting installations. Such approval, or the Engineer's failure to request this information, does not relieve the Contractor of responsibility for the installation.

F. EXPLOSIVES STORAGE

Explosives shall be stored only where directed by the Engineer and in approved storage structures. These structures shall be kept locked at all times except for inspection and for delivery and storage of explosives.

G. MEASUREMENT AND PAYMENT FOR EARTH EXCAVATION

Payment for added or deducted earth excavation shall be at unit prices quoted for earth excavation and the quantity shall be computed from cross-sections measured from the bottom of the grades indicated on the drawings and horizontally to the neat dimensions of the graded area, ditch, etc., as determined by survey.

2.01 EXCAVATION (Cont'd)

H. MEASUREMENT AND PAYMENT FOR ROCK EXCAVATION

Excavation of material claimed as "rock excavation" shall not be performed until the material has been cross-sectioned and classified in accordance with the foregoing definition by the Engineer. "Rock excavation" shall be paid for in accordance with the unit prices agreed upon beforehand.

I. MEASUREMENT AND PAYMENT FOR STRUCTURAL EXCAVATION

Payment for structural excavation shall be at the unit prices quoted for "Structural Excavation" as determined by the quantity of material from the final surveyed excavation line to the excavation line two (2) feet above the plan structural foundation elevation. Both excavation lines shall be determined by survey. Rock excavation to structural foundation elevation, if necessary, shall not be considered as structural excavation but will be paid for as rock excavation.

2.02 COMPACTION

A. GRANULAR MATERIAL

Granular fill shall be compacted in twelve (12) inch layers. Compaction shall be performed to obtain 75 percent relative density to final grade.

The relative density (D_r) shall be as defined herein below:

In terms of void ratios:

$$D_r = \frac{e_{\max} - e}{e_{\max} - e_{\min}} \times 100$$

D_r = relative density of granular material expressed in percent

e_{\max} = void ratio of granular material in its loosest state¹
by laboratory procedures

e_{\min} = void ratio of granular material in its densest state¹
by laboratory procedures

e = void ratio of granular material in place²

¹ Relative Density of Cohesionless Soils, ASTM Designation D2049-64T.

² Density of Soil in Place by the Rubber-Balloon Method, ASTM Designation D2167-66.

2.02 COMPACTION (Cont'd)

In terms of dry unit weight (γ_d):

$$D_r = \frac{\gamma_{dmax} (\gamma_d - \gamma_{dmin})}{\gamma_d (\gamma_{dmax} - \gamma_{dmin})} \times 100$$

D_r = relative density of granular material expressed in percent

γ_{dmax} = maximum dry unit weight of granular material by laboratory procedures

γ_{dmin} = minimum dry unit weight of granular material by laboratory procedures

γ_d = dry unit weight of granular material in place

B. COHESIVE MATERIAL

Cohesive fill shall be compacted in six (6) inch layers of loose material. Each layer of cohesive materials shall be spread uniformly and compacted to at least 95 percent of the maximum dry density obtained by the Test for Moisture-Density Relations of Soil Using Ten Pound Rammer and 18 Inch Drop, ASTM Designation D1557-.64T. Method A (Modified Proctor).

Fill placed by the Contractor that does not fulfill the requirements of these specifications shall be removed and properly replaced at no cost to the Commonwealth of Pennsylvania.

2.03 BACKFILL

A. GENERAL

Backfill shall not be placed until after the Engineer has approved the Work and material which will be covered. Backfill shall be placed to the elevations shown on the Drawings.

All backfill shall be placed in accordance with Section 2.02 Compaction, unless otherwise directed by the Engineer. Backfill shall not be placed in water.

Backfill shall contain no frozen material, ashes, rubbish, combustible or decomposable material, nor any other material which the Engineer deems unsuitable for this purpose. If none of the excavated material is deemed suitable for use as backfill by the Engineer, the Contractor shall provide proper material from some other source approved by the Engineer unless otherwise

2.03 BACKFILL (Cont'd)

specified. Rock, or broken concrete, shall not be used in backfill without permission from the Engineer, and then only in accordance with his direction.

Sheeting and bracing shall be removed before backfilling is completed.

B. BACKFILL FOR TRENCHES

After the piping and conduit have been approved, trenches shall be backfilled with suitable granular material compacted to 75 percent relative density. Backfill should be placed uniformly along both sides. In general 75 percent relative density shall be maintained to final grade unless otherwise directed by the Engineer but in no case shall any fill be approved below the centerline of a pipe that does not satisfy the requirement of 75 percent relative density.

All pipe must be bedded. and encased with a minimum of six (6) inches. of cover all around the pipe before additional backfill material is placed in the trench.

The backfill shall be carefully placed and thoroughly compacted under and around the pipe and between the cradles or grillage, wherever installed, until a firm bed and continuous support on the bottom and. sides is secured.

C. BASIS FOR PAYMENT

Payment for this item shall be the contract unit price per cubic yard of material compacted in place in the fill. Volume shall be determined by cross-section method.

2.04 ROCK SURFACES

Before any concrete is placed against rock, the latter shall be thoroughly washed and scrubbed, and scrupulously cleaned of all dirt, gravel, boulders, scale, loose fragments, film and other objectionable substances by air, water jetting or brooming. The rock surface shall be moistened immediately before the placement of concrete. No concrete shall be placed on this rock until the surfaces have been inspected and approved by the Engineer.

If solid rock is encountered prior to reaching the required elevation, the Engineer shall be notified immediately. A determination as to the need for continued excavation will be made by. the Engineer. The Engineer shall approve the method for all rock excavation.

2.05 CONCRETE AND CONCRETE WORK

A. STANDARDS

All concrete and concrete work shall be in accordance with the "Building Code Requirements for Reinforced Concrete", ACI 318-63.

B. CEMENT

The portland cement shall conform to "Specifications for Portland Cement", ASTM Standards, designation C-150-62, Type I.

C. CONCRETE STRENGTH

Structural concrete shall have a minimum ultimate compressive strength of 3,000 psi at 28 days and shall have a minimum of 5-1/2 sacks of cement per cubic yard. Maximum slump shall be four (4) inches.

D. CONCRETE MIX

The Contractor shall submit copies of the proportions of the proposed mixes to the Engineer for approval and shall also furnish evidence, satisfactory to the Engineer, that the proportions selected will produce concrete of the quality specified.

E. READY-MIXED CONCRETE

Ready-mixed concrete shall conform to "Specifications for Ready-Mixed Concrete", ASTM C94-62.

F. CURING

Concrete shall be maintained above 50⁰ F and below 100⁰ F in a moist condition for at least seven days after placing. The method of curing shall be subject to the approval of the Engineer.

G. ADVERSE WEATHER CONDITIONS

Concrete shall be protected against adverse weather conditions in accordance with "Recommended Practice for Winter Concreting," ACI 604-56 and "Recommended Practice for Hot Weather Concreting," ACT 605-59, except that accelerators such as calcium chloride and antifreeze compounds shall not be used.

H. BASIS FOR PAYMENT Payment for this item shall be at the contract unit price per cubic yard of concrete placed as determined by the certified mix plant truck tickets and as verified by calculated volumes contained within the forms. When discrepancies occur between the truck ticket volumes and the calculated volumes, the Engineer and the Contractor shall agree in writing to the calculated volume and this volume shall be used for payment.

2.06 ACCESSORIES

Use of admixtures for concrete such as air entertainment and/or a water reducing and densifying agent to improve workability and reduce drying shrinkage is acceptable with the approval of, or at the direction of, the Engineer.

Curing compounds for concrete shall be used only as approved or directed by the Engineer.

Expansion joint filler shall be of not less than one-half (1/2) inch thickness and width as shown on the Drawings, or as directed by the Engineer, and shall consist of pre-molded bituminous joint material, Carey "Elastite" or equal.

Polyethylene plastic sheet under slabs on grade shall be .006 inch thick, Visqueen, or equal, as approved by the Engineer.

Waterstops shall be PVC dumbbell or similar type, Vinylex Waterstop or approved equal. Size shall be as indicated on the Drawings.

Reinforcing bars shall be deformed bars of new billet steel, intermediate grade or other grades as specified on Drawings and shall conform to the "Standard Specifications for Billet Steel Bars for Concrete Reinforcement". ASTM A-15; "High Strength Bars for Concrete Reinforcement", ASTM A-432; and "Standard Specifications for Minimum Requirements for the Deformations of Deformed Steel Bars for Concrete Reinforcement", ASTM, A-305 according to the latest revision.

Welded wire fabric for concrete reinforcement shall be of size indicated on the drawings. The welded wire fabric shall conform to the requirements of "Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement". ASTM A-185 and "Specifications for Fabricated Steel Bar or Rod Mats for Concrete Reinforcement ASTM A-184.

Bar supports, ties, and spacers shall be of steel or other acceptable material of an approved design, and adequate to insure against displacement of the reinforcement during the course of construction. Embedded metal thresholds, curb angles, base and foundation bolts, floor plates, frames and covers and other miscellaneous steel items shall be fabricated true and straight to conform to the following, unless otherwise noted: Structural steel shall conform to the requirements of "Standard Specifications for Structural Steel". ASTM A-36.

Reinforcement shall be stored in such a manner as will avoid excessive corrosion or coating with objectionable matter.

2.07 TESTS

The Contractor shall guarantee and take concrete cylinder tests to show that all concrete mixes will attain at 28 days the minimum compressive design strength or strengths as specified. When seven-day tests are made, the concrete shall be not less than two-thirds of the strength required at 28 days. If either the seven-day or the 28-day tests do not attain required strength, the concrete shall be deemed to be defective. Cylinder tests shall be taken for every 50 cubic yards of concrete placed or for separate placements less than 50 cubic yards. Results of such tests shall be submitted to the Engineer in writing.

If the concrete shall prove defective and the imperfection in the same is not of such magnitude or importance as to make the Work dangerous or undesirable, the Engineer shall have the right and authority to retain such Work, but shall make such deductions in the final payment therefore as may be just and reasonable.

Where tests are required, the Contractor shall employ an approved testing service or laboratory to conduct and record the results of such test. The Contractor shall perform any and all remedial measures and/or replacements as directed by the Engineer which may be required because of defective workmanship or materials. All costs of such Work, including all costs of performing tests, shall be borne by the Contractor.

2.08 FORMWORK

Forms shall conform to the shape, lines, grade and dimensions of the members as shown on the Drawings. One inch chamfer strips shall be provided in the forms at all exposed corners. They shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports and shall be able to resist the pressure due to weight, tamping, and vibration of the concrete without deflection from the prescribed lines. They shall be properly braced and tied together so as to maintain position and shape. Temporary openings shall be provided to facilitate cleaning and inspection immediately before depositing concrete.

Internal ties shall be adjustable to permit tightening of the forms and shall be so arranged that after the forms are removed, all metal shall be not less than one inch from any surface. All tie holes shall be properly plugged with nonshrink mortar.

Forms shall be coated with an approved form oil or other coating material to prevent sticking of the concrete.

All forms shall be thoroughly cleaned of all debris, foreign matter, snow and ice before concrete is placed.

2.08 FORMWORK (Cont'd)

Removal of forms shall be accomplished in such a manner as will prevent injury to the concrete and will insure the complete safety of the structure and personnel.

Payment for this item shall be included in the contract unit price per cubic yard of placing concrete.

2.09 REINFORCEMENT

The Contractor shall place all reinforcing materials as indicated on the Drawings together with all necessary wire, ties, chairs, spacers and supports.

Any field fabrication of reinforcing bars shall conform, to the dimensions shown on drawings. Bends shall be made around pins, the diameter of which varies with the bar sizes as specified by ACI Code. Heating for bending will not be permitted.

Reinforcement shall be accurately placed in accordance with the Drawings and shall be adequately secured in position by metal chairs and spacers that are acceptable to the Engineer.

Reinforcement, at the time concrete is placed, shall be free from loose rust, scale or other coatings that will destroy or reduce the bond.

Splices shall be made only where shown on Drawings or as approved by the Engineer.

Dowels through construction joints shall be placed as shown on the Drawings.

Payment of this item shall be included in the contract unit price per cubic yard of placing concrete.

2.10 DAMP PROOFING UNDER SLABS ON GRADE

A layer of polyethylene plastic sheet material, Visqueen or equal, shall be laid on the ground surface before reinforcement is placed or concrete is placed to avoid excessive moisture losses. This plastic sheet material shall be lapped twelve (12) inches on all edges and twelve (12) inches up side and end walls and must be protected against puncture during construction. Plastic shall be not less than .006 inches thick.

2.11 EMBEDDED METAL.

All angles, channels, plates, anchor plates, stair treads, anchor bolts, castings, pipe sleeves, pipes and other inserts or embedded items shall be installed as shown on the Drawings. Special care shall be taken to place and maintain them to the proper lines and grades. They shall be thoroughly braced to prevent movement during the progress of the Work. Embedded metal must not be painted where in contact with concrete.

No claims will be allowed the Contractor for extra Work resulting from misalignment of embedded metal.

Payment of this item shall be included in the contract unit price per cubic yard of placing concrete.

2.12 PREPARATION OF EQUIPMENT AND PLACE OF DEPOSIT

Before placing concrete, all equipment for mixing and transporting the concrete shall be cleaned, all debris, ice and water shall be removed from the places to be occupied by the concrete, and forms shall be thoroughly cleaned of ice or other coatings.

2.13 MIXING OF CONCRETE

Ready-mixed concrete shall be, mixed. and delivered in accordance with the requirements of "Specifications for Ready-Mixed Concrete", ASTM, C-94. The interval between trucks for placing shall not exceed thirty (30) minutes and the time elapsing between loading concrete at the ready-mix plant and its deposition in the forms shall not exceed one hour or as approved by the Engineer.

Delivery slips shall be furnished for each load of ready-mix or transit-mix concrete, certified by concrete plant engineering inspectors to indicate complete description of mix and time truck has been dispatched from mixer or batcher.

2.14 CONVEYING

Concrete shall be conveyed from mixer to place of deposit by methods that will prevent segregation, loss of material, and that will insure a practically continuous placing of concrete.

Chutes shall be cleaned with water and stiff wire brushes before each use but water shall not be permitted in the chute while concrete is being conveyed in the chute.

2.15 CONCRETE PLACEMENT

No concrete shall be placed until the Engineer has inspected the place of deposit, reinforcement, inserts, conduit, pipe lines and any other items to be incorporated.

2.15 CONCRETE PLACEMENT (Cont'd)

Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. In walls or units of considerable height, the concrete shall not be permitted to fall freely more than five (5) feet or in such a manner as to cause segregation. For heights greater than five (5) feet elephant trunks shall be used. When it is necessary to move concrete laterally, metal chutes shall be used, provided that the concrete is not allowed to become segregated.

No concrete that has partially hardened or been contaminated by foreign material shall be deposited in the Work, nor shall re-tempered concrete be used. When concreting is started, it shall be carried on as a continuous operation until the placing of the section is completed. The top surface shall be level, unless otherwise specified.

All concrete shall be thoroughly consolidated during placing, and shall be thoroughly worked around reinforcement, embedded items and into the corners of forms. Mechanical vibrators may be used upon approval by the Engineer. The Engineer shall approve all vibrating methods. At no time shall the vibrator be permitted to lay in a horizontal position in the fresh concrete.

Where conditions make consolidation difficult, or where reinforcement is congested, batches of mortar containing the same proportions of cement to fine aggregate as used in the concrete, shall first be deposited in the forms to a depth of at least one inch. This mortar shall be followed immediately by concrete of the specified mixture.

Concrete shall be placed in the forms immediately after mixing. Working or flowing of concrete along the forms from point of deposit will not be permitted, and it shall be spaded or manipulated the minimum practical amount for proper placement. The concrete next to the forms shall be spaded and the coarse aggregate worked back from the form. Care must be taken to work the concrete under and around all reinforcement without displacing it.

Excavations shall be kept free of water while concrete is being deposited therein. Green concrete shall be protected from running water. Water which accumulated on the surface of the concrete during placing shall be removed by absorption with porous material in a manner that prevents removal of cement.

Where new concrete is to be bonded to existing concrete, the existing surface shall be cleaned and roughened thoroughly, all loose particles removed, and the surface flushed with neat cement grout immediately before the new concrete is placed.

2.16 CONSTRUCTION JOINTS

Construction joints shall be constructed and located as shown on the Drawings.

Where construction joints are made in plain and reinforced concrete of monolithic construction, a tongue and groove joint key shall be constructed as shown on the Drawings. All construction joints shall be keyed.

2.17 CURING

Freshly placed concrete shall be protected from injurious action by sun, rain, water, frost, and mechanical injury. Concrete shall not be allowed to dry out from the time it is placed until cured for the following length of time or as directed by the Engineer:

(a) Reinforced concrete foundations, retaining walls, pedestals and other structures not otherwise specified -- not less than seven (7) days.

(b) High early strength concrete -- not less than three (3) days.

Curing shall be accomplished by keeping the surface of the concrete continuously wet. Where wood forms are left in place for curing, they shall be loosened and both sides shall be kept sufficiently damp at all times to prevent opening at the joints and drying out of the concrete. All portions of the concrete shall be kept moist and at temperatures of not less than 50 degrees Fahrenheit for the full curing periods or as directed by the Engineer. Liquid membrane-forming curing compounds may be used in lieu of moist curing when approved or directed by the Engineer and shall be applied to exposed surfaces of formed concrete and to floor surfaces at conclusion of finishing, and to formed surfaces within a maximum of two hours after removal of forms.

Forms shall be left in place not less than the period specified for curing unless adequate provision is made to keep the surfaces of the concrete wet. Supporting forms shall not be removed until the member has acquired sufficient strength. Shores shall not be removed before the structure is completely safe and not before the concrete has cured for seven (7) days.

2.18 ACID RESISTANT COATING

A 1/2 inch thick layer of "Carbo-Alkor Corrosion-Proof Cement" as manufactured by Atlas Minerals and Chemicals Division, Mertztown, Pennsylvania, or approved equal shall be applied to all exposed

2.18 ACID RESISTANT COATING (Cont'd)

concrete surfaces. The Contractor shall conform to the manufacturer's instructions for mixing and application.

Payment for this item shall be included in the contract unit price per cubic yard of placing concrete.

2.19 TOPSOIL

The Work included under this section consists of furnishing, placing, spreading and rolling selected topsoil at the locations shown on the Drawings.

Topsoil shall be high-quality soil consisting of field or pasture loam which contains a good supply of humus and a high degree of fertility.

A. Areas to receive topsoil shall be brought to within 6 inches of the cross section and finished smooth and uniform before the topsoil is applied. The topsoil shall be evenly placed and spread over the graded area and all stones, brush, roots, large clods and other objectionable materials shall be removed from the topsoil area and disposed of as directed by the Engineer. The topsoil area shall be compacted by one pass of a roller weighing not less than 50 pounds per linear inch of length of drum. The compacted depth of topsoil shall be 6 inches. Topsoil shall not be placed in a condition detrimental to proper grading and seeding as determined by the Engineer.

B. Payment for topsoil accepted in place will be made at the contract unit price bid per square yard for "Topsoil," which price and payment shall constitute full compensation for furnishing, placing, spreading and rolling, of all topsoil, and for all labor, tools, equipment and incidentals necessary to complete the work. Payment will be based on the plan quantities unless changes in quantities are approved by the Engineer.

2.20 SEEDING

A. GENERAL

This work consists of preparing the seed bed, furnishing, transporting and placing the seed and other materials required in the seeding operations on the slopes of the emergency drainage ditch indicated on the Drawings.

2.20 SEEDING (Cont'd)

No seed shall be sown during high winds or when the ground is not in a proper condition for seeding. Any equipment to be used shall be subject to approval of the Engineer. Prior to starting work, seeders shall be calibrated and adjusted to sow seeds at the proper seeding rate. Equipment shall be operated in a manner to ensure complete coverage of the entire area to be seeded.

Seed shall be sown so that in general the seed is at an average depth of 1/4 inch.

B. SEEDING MIXTURES

The seeding mixture shall be as follows:

- a. Spring Seeding
 - 20 lbs./acre - Crown Vetch
 - 10 lbs./acre - Perennial Ryegrass
- b. Fall Seeding
 - 20 lbs./acre - Crown Vetch
 - 40 lbs./acre - Winter Vetch

C. BASIS FOR PAYMENT

This work shall be paid for at the Contract unit price per square yard for seeding.

2.21 GALVANIZED CHAIN LINK FENCE

This item shall include furnishing and installing all of the galvanized chain link fence and gate to be placed on top of the Cummings shaft walls as shown on the Drawings.

All materials shall be of galvanized and the fence runs and gates shall be five feet high as shown on the Drawings.. The parts shall be furnished as follows:
a. Fabric 2" mesh #9 gage to the full fence height. b. H column line posts 1.875" x 1.625". c. H beams maximum spacing 10' c to c. d. Terminal posts 2" diameter..

2.21 GALVANIZED CHAIN LINK FENCE.(Cont'd) -

f. Gate; Gate frames of 1-7/8" nominal O.D. with galvanized pressed steel fittings securely riveted. Chain link fence installed in frame by tension bars with hook bolts. Gate to be equipped with a positive type latching device with provision for padlocking.

Three strand barbed wire with extension arms at an angle of 45⁰ away from the shaft. The topmost barbed wire located approximately 12" above the fabric and approximately 12" out from the fence line. Extension arms for line posts to be pressed steel or casting base with pressed. steel arms. Pressed steel to be a minimum of 14 gauge and arms are to be provided with slots for securely fastening the barbed wires by means of heavy wire pins.

All posts shall be set in sockets in the top of the walls and secured with cement grout..

Basis for payment shall be for the Contract lump sum for Galvanized Chain Link Fence, which price shall be full compensation for furnishing, all of the labor, materials, equipment tools, and any incidentals required to complete the work in accordance with the Plans and these Specifications.

2.22 DEMOLITION OF EXISTING STRUCTURES

As shown on the Drawings, portions of structures and bridges that require removal from the work areas shall be moved to a waste storage area designated and/or approved by the Engineer. Foundations shall be removed to a depth of four (4) feet below grade, and any excavations filled with properly compacted fill placed in accordance with Section 2.02.

2.23 VALVES AND VALVE HOUSINGS

The Contractor shall furnish and install all valves and valve housings at the locations shown on the drawings. The valve types' and sizes are noted on the Drawings.

The valves shall be stainless steel. Standard pipe flanges, bolts and gaskets shall be furnished with the valves.

The valve housings shall be fabricated and constructed in accordance with the Drawings.

The basis for payment will be the contract lump sum to include the pipe, valve and valve housings at Cummings shaft, E-4 borehole and the intersection of the pipe between E-1 and E-2 and the emergency ditch to mine opening E-3.

2.24 PIPE ENCASEMENTS AND INSULATION

The Contractor shall provide all labor, equipment and parts to construct the required encasements and insulation for the drainage pipe between mine openings E-1 and E-2.

The type, size and method of encasements and insulation for the pipe are shown on the Drawings.

Subject to the Engineer's approval, the Contractor shall make full use of the existing structural steel channels for fabricating the encasement for that portion of the pipe to be supported by the concrete abutments.

The basis of payment for this item shall be the Contract unit price per lineal foot of pipe to be encased and/or insulated.

2.25 PIPING BETWEEN E-1 and E-2 MINE OPENINGS

Furnish and install a "Naylor" spiral welded steel pipe, 18-inch I.D. .1644 inch wall thickness drainage pipe coated inside and outside with a 12 mil coal tar epoxy or approved equal to transfer the mine acid water from the E-1 mine opening to the E-2 mine opening.

The length, type and details of the pipe are shown on the drawings. The Contractor shall lay the pipe to the lines and grades indicated on the drawings. Fittings to be supplied include couplings and, if required, an 18-inch I.D. prefabricated pipe Y section. Pipe lengths shall not exceed 25 feet to allow sufficient expansion and contraction at the Heavy Duty Wedgelock Couplings. The joining of the pipe and installation of the fittings shall be in accordance with the manufacturer's recommendations.

The quantity of pipe to be paid for under this item shall be the number of lineal feet installed, measured along the centerline of the pipe to the nearest tenth of a foot.

Basis of payment will be the Contract unit price per lineal foot, which price shall include full compensation for furnishing all materials, equipment, fittings, tools and labor not otherwise provided herein to accomplish the work as shown on the plans and as specified herein.

2.26 MINE BARRIER ACCESS GATES

The Contractor shall provide all parts, material and labor to fabricate and install all access gates required for the Reinforced Concrete Mine Barriers as indicated on the Drawings. Mine barrier access gates are to be fabricated to fit the field dimensions.

The basis for payment shall be the Contract lump sum per access gate.

2.27 E-3 WOOD BARRIER

The existing wood barrier at the E-3 mine opening shall be removed prior to construction and replaced after the work is completed as directed by the Engineer.

The basis for payment shall be the Contract lump sum.

2.28 PACKERS & PLUGGING:

A. General

At the location known as E-4, three (3) boreholes have been electronically calipered and reasonably accurate information has been obtained as to their diameters and the desired locations for placing packers. A fourth hole may exist and shall be sealed. The approximate arrangements of the boreholes and the core boring drilled immediately south of Hole No. 4 is indicated. on the drawings:

B. Installation Procedure Boreholes Nos. 1, 3 and 4

Packers of the appropriate size shall be "Lynes Production Injection Packers for Plugging" or "Lynes Inflata-Plug" as manufactured by Lynes, Inc., Houston, Texas or one of approved equal manufacture. The above packers must be equipped with a disconnect coupling.

- a) The sides of the hole shall be reamed from top to bottom to obtain a reasonably clean rock surface allowing the plugging packer to be seated and providing a good bonding surface for the cement grout mix.
- b) A 5-5/8" outside diameter production injection packer connected to tubing string with disconnect coupling and lug nipple shall be installed an approximate depth of 90 feet or as directed by the Engineer.
- c) Water shall be pumped through the tubing string to pressures up to 1000 psi to hydraulically set the packer.
- d) The tubing shall be turned to disconnect from the packer and cement grout shall be continuously pumped through the tubing until a clean fresh grout mix overflows the top of the hole.
- e) As tubing joints are withdraw* from the hole, grout pumping shall continue to fill the displacement volume of the pipe.

2.28 PACKERS & PLUGGING (Cont'd)

C. INSTALLATION PROCEDURE BOREHOLE NO. 2

The packer of an appropriate size shall be a "Lynes External Casing Packer" manufactured by Lynes Inc., Houston, Texas, equipped with a solid cement baffle collar or shoe, or one of approved equal manufacture.

- a) The sides of the hole shall be reamed from top to bottom to obtain a reasonably clean rock surface allowing the plugging packer to be seated and providing a good bonding surface for the cement grout mix.
- b) A 12-inch O.D. External Casing Packer and an 8-inch diameter PVC Plastic pipe shall be installed to a depth of + 90 feet or as directed by the Engineer.
- c) The packer shall be set hydraulically, and cement grout pumped to the top of the packer through a one-inch O.D. pipe.
- d) Pumping shall be continuous until a clean grout overtops the hole.
- e) The cement baffle collar or shoe shall be removed by rotary drilling after the grout has set for a minimum of 72 hours and the 8-inch diameter valve is installed as indicated on the Drawings.
- f) The Contractor shall exercise extreme care to prevent damage to the plastic pipe during the rotary drilling.
- g) Basis for payment - Payment for this item shall be the contract lump sum per packer and plugging for each borehole.

2.29 CALIPERING OR SECTION GAUGING

Additional caliper or section gauge logging complete with logs may be required at two boreholes. This logging shall be accomplished with an instrument designed to measure the diameter and cross-sectional area of the borehole. The instrument shall be a motorized three arm caliper with independent arm action and shall continuously record on chart paper by a recorder at the surface the actual size of the borehole for its full depth.

Basis for payment shall be based on the Contract Lump Sum for calipering per borehole.

2.30 REMOVE EXISTING MINE BARRIER

The Contractor shall enter the E-1 mine opening to remove an existing masonry barrier located approximately 1000 feet into the mine shaft for the purpose of allowing water to flow to the E-1 mine opening after the Cummings Shaft closure is completed.

The location of the barrier to be removed and other barriers are shown on the Drawings.

The method of removal shall be approved by an authorized representative from the Department of Mines and Mineral Industries, Commonwealth of Pennsylvania and the Engineer.

Basis for payment shall be all costs incurred by the Contractor plus a fixed percentage-for overhead and, profits to be designated by the Department of Mines and Mineral Industries, Commonwealth of Pennsylvania.

2.31 EXPLORATORY EXCAVATION

The Contractor shall furnish all labor, equipment, and materials necessary to excavate possible locations of abandoned boreholes and shafts as designated by the Engineer.

Basis for payment shall be all costs incurred by the Contractor, plus a fixed percentage for overhead and profits to be designated by the, Department of Mines and Mineral Industries, Commonwealth of Pennsylvania.

INSTRUMENTATION AND DRILLING

3.01 INSTRUMENTATION AND DRILLING

At the locations shown on the Drawings eleven standpipes (or piezometers) and well points shall be installed and an NX core boring shall be drilled and pressure tested to the depths designated by the Engineer.

A. CORE DRILLING

A series M double-tube core barrel with a diamond bit and reaming shell or equivalent shall be used to recover rock cores-of the sizes specified above. 'Soft or decomposed rock shall be sampled with a driven sampler whenever possible.

The Contractor shall ensure that water is available at all times to satisfactorily core the boreholes.

The core drill mechanisms shall be of hydraulic feed type.

The core barrel shall be in efficient operating condition.. The drill rods shall be series N only or approved equivalent. No drilling will be permitted with drill rods that are not straight.

In coring rock, including shale, claystone and coal, the Contractor shall control the speed of the drill and the drilling pressure, amount and pressure of. water, and length of. run to give the maximum recovery from the rock being drilled. In no case shall the first length of drill run exceed three feet. No grinding of core kill be permitted. The Contractor must be expert in detecting the blocking of rock core in barrels and at any suspicion that such is occurring, the barrel must be removed from the hole, the core removed, and coring shall not be continued until care has been taken to see that the core barrel, and bit and other equipment is in satisfactory operating condition.

If poor recovery is experienced due to failure of the Contractor to consider the above factors after having been given advance warning by the Engineer, the hole shall be redrilled at the expense of the Contractor.

Should any rock formation be so soft or broken that pieces continually fall into the hole to cause unsatisfactory coring, the hole shall be lined with flush joint casing to a point below the broken formation. The size of the flush joint casing shall permit securing of the size of the core specified. This procedure shall be repeated as many times as may be necessary to keep the hole clean.

Where soft or broken rocks are anticipated by the Engineer, the Contractor shall reduce the length of runs to less than five feet in

3.01 INSTRUMENTATION AND DRILLING (CONT'D)

order to reduce the core loss and core disturbance to the minimum. Failure to comply with the foregoing procedures when ample warning of unusual subsurface conditions has been received in advance shall constitute justification for the Engineer to require re-drilling at the Contractor's expense of any boring from which core recovery is unsatisfactory.

Inasmuch as the function of rock borings includes determination of width, direction, extent and spacing of rock fractures or voids that may have occurred due to subsidence, or otherwise, the Contractor shall exercise particular care in recording water losses, artesian pressures, rod jerks or any other unusual coring experience which, supplementing the core record, will throw light on the nature and extent of fracturing or voids. Fractures and their estimated widths shall be marked in the core boxes and the location of voids shall be clearly indicated.

Immediately upon recovery of the core barrel from the hole, the rock core shall be carefully removed from the barrel, classified and measured for percentage of recovery. If the rock is in either a soft or broken condition the core barrel shall be dismantled horizontally and the core pushed into a trough. Rock cores shall be placed in the sequence of recovery in well-constructed wooden boxes, provided by the Contractor. Wood partitions shall be placed at the end of each core run, and between rows and the depth from the surface of the boring to the top and bottom of the drill run shall be marked on the wood partitions. A wood partition showing the length of core lost shall be placed at the end of each run immediately above the partition showing the depth of the bottom of the run. The order of placing cores shall be the same in all core boxes. The top of each core obtained and its true elevation shall be clearly and permanently marked in each box.

The core boxes shall be marked with the number of the borehole and depths from which the cores were recovered.

The elevation of change of rock strata shall be clearly marked within each box. Special care shall be taken to locate and note the elevation and thickness of all claystone layers, soft decomposed rock, cavities, or rock fractures. These shall be clearly shown in each box and on the drill log. The total length of core obtained and the corresponding distance drilled shall be clearly shown on the log of each boring.

Rock cores from two different borings shall not be placed in the same core box.

When each boring is complete, the box containing the cores shall be provided with a tight lid. The number of the boring shall be clearly and permanently marked on the top and on both ends of each box with paint.

3.01 INSTRUMENTATION AND DRILLING ('CONT'D)

The core boxes and partitions shall be so constructed as to accommodate 1.6 lineal feet of core in four rows of approximately four feet each, and shall restrain the cores against shifting during transport. The boxes shall be constructed with hinged tops and secured with several screws.

The Contractor shall provide suitable dry storage for all rock cores until the completion of the Work, at which time they shall be delivered to the destination directed by the Engineer.

B. PACKAGING, PROTECTING AND SHIPPING OF SOIL OR ROCK SAMPLES

All samples shall be properly labeled and packed in suitable containers to protect against damage from shifting of samples, in boxes or breakage of glass jars or otherwise while in transit. All samples shall be carefully packed to prevent freezing or damage during storage or shipment. Samples shall be properly marked as "Fragile," "Keep Away From Heat or Freezing." All samples shall be shipped to the location indicated by the Engineer.

C. CLASSIFICATION OF ROCK CORES

Rock shall be described in accordance with the following items of classification:

(a) Type:

Limestone
Shale
Claystone
Sandstone
Coal
Granite
Gneiss
Schist

Where necessary, one adjective shall be used to modify the type of rock.

(b) Structure:

Laminated Massive

(c) Condition:

Solid
Broken
Fractured with stains
Fragmented
Weathered (rotten), seamy

3.01 INSTRUMENTATION AND DRILLING (CONT'D)

(d) Hardness:

Soft
Medium soft Medium hard Hard
Very hard

(e) Color

Basic color, such as yellow, brown, red, gray, blue or black and modify the color if necessary using adjectives as light, dark, mottled or mixed.

D. STANDPIPE AND WELLPOINT

Standpipes (piezometers) complete with wellpoint shall be installed in each new NX core boring hole. The pipe for the standpipe shall be one-inch diameter PVC Plastic pipe. The pipe shall be attached to the wellpoint as shown on the Drawings and shall be grouted into place with neat cement. A cement basket, as supplied by Halliburton Company or approved equal, shall be attached to the one-inch pipe. Grouting of the annulus between the 1-inch pipe and the rock shall be done by setting a 1/2-inch I.D. pipe near the top of the grout basket and pumping a neat cement mix of one part cement to one part water continuously until it overflows the top of the borehole. The grout pipe shall be left in place until the Engineer directs the Contractor to withdraw it. Continuous uplift pressure must be maintained on the grout ring and continued pumping of grout maintained in the event grout leaks develop. In any case, the oneinch piezometer pipe must be held securely in position until the grout has attained its required set time. (Minimum set time 7 days.)

The wellpoint shall be a standard 1-1/4 inch diameter wellpoint 3'0" long with a 24-inch stainless steel screen, and as detailed on the Drawings.

E. PRESSURE TESTING (HYDRAULIC)

Hydraulic pressure testing shall be interpreted to mean the operation of forcing water under pressure into subsurface rock formations through pre-drilled NX or BX test holes for the purpose of determining the subfoundation leakage conditions and grouting requirements. The Contractor shall perform all the work and furnish all equipment and supplies required to complete these operations.

Pressure testing equipment to be furnished by the Contractor shall include the following:

- a) Water pumps with minimum capacities of 50 g.p.m. when operating at discharge pressures of 150 psi.

3.01 INSTRUMENTATION AND DRILLING (CONT'D)

b) Double expander packers for NX and BX test holes with rubber expansion elements six inches in length set five feet apart.

c) Water pipes so arranged that water may be admitted either below the bottom expander element or between the two expanders, and connected to the pressure pump through two swing check valves, water meter, and pressure gage.

d) Supplies shall include all accessory valves, gages, stopcocks, plugs, two sets of expanders, water for testing, standby pumps, fuel, pipes, pressure hose, and tools necessary for maintaining uninterrupted tests for each boring to be tested.

Prior to testing each boring, the Contractor shall test the apparatus on the ground surface by inserting and sealing it into NX flush joint casing. A pressure of 100 psi should then be maintained for five (5) minutes with no indication of leakage. The Contractor should exercise caution when lowering the apparatus into position so that the rubber packers are not damaged.

All pressure tests shall be made in the order and manner specified in this paragraph. The Contractor shall pressure test each hole in five-foot sections, commencing at the bottom of the boring and progressing upward to the top of rock. For each lift, the maximum water pressure employed should be one pound per square inch per foot of rock present above the top expander, but in no case shall the pressure exceed 100 pounds per square inch. The Contractor shall develop the maximum pressure specified by the Engineer in accordance with the above statements, and, maintaining this pressure constant for a minimum period of five (5) minutes, record the total volume of flow in gallons or cubic feet over this time interval. After completion of the above flow test, the pressure pump and flow into the boring shall be simultaneously cut off, and the time noted for each drop of ten psi in pressure. These tests shall be repeated until the results are satisfactory to the Engineer. These procedures shall apply to each five-foot lift tested. If the expanders are not adequately sealed against the rock, or are in an area of broken rock, the leakage may be observed at the surface by the return of water, in which case, the pressure test apparatus should be lowered one foot, and the test repeated. Such records shall be submitted on forms similar to the one attached to these specifications. Because of the very significant bearing of such tests on estimating subsurface leakage, and the ultimate grout treatment requirements of foundations, the Contractor shall take every precaution to make certain that continuous and reliable pressure tests are completed as specified. If, in the opinion of the Engineer, either the condition of the testing equipment or its assembly and arrangement are thought to be faulty, the Contractor may be required to make a series of check tests at his own expense.

The Contractor shall prepare duplicate logs for each hole that is pressure tested. Separate log sheets shall be submitted for each boring.

3.01 INSTRUMENTATION AND DRILLING (Cont'd)

The logs shall indicate the type of pump used, boring number, top and bottom depths below the ground surface of each interval tested, pressure employed in each interval, rate of water injection, time interval over which different pressure ranges were obtained, height of the water swivel above the ground surface, and any other observations pertinent to subsequent grouting requirements or foundation treatments specified in the preceding paragraphs. The first copy of all such records shall be submitted to the Engineer.

F. SOIL BORING

Where necessary, as requested by the Engineer, auger borings using an auger with a minimum diameter of three inches shall be drilled. The auger teeth shall be high-grade steel or carborundum cutting teeth or equivalent. The augering shall be carried out continuously from the ground surface to refusal on firm, hard bedrock. From the feel of the cutting bit and the chippings that come to the surface, the Contractor shall give the description of the soils encountered and their approximate depth below the ground surface.

The Contractor shall clearly note in his records where the auger passes from soil to decomposed rock.

G. RECORDS AND REPORTS

The Contractor shall keep a continuous field record of the operation of each boring. The record shall consist of an accurate log and description of the materials encountered, a record of samples and rock cores obtained, and a record of the samplers, driving weights and casing used. One copy of the field record shall be made available to the Engineer at the completion of each day's work. The following data shall be included in these reports.

- Dates and times of beginning and completion of work.
- Identifying number and location of test boring.
- Ground surface elevation at the boring.
- Diameter and description of casing.
- Total length of each size of casing.
- Length of casing extending below ground surface at the completion of the boring.
- Weight, number of blows, and drop of hammer used to drive the casing each successive foot.
- Elevation of ground water table and other water levels as required.
- Any sudden dropping of drill rods or other abnormal behavior.
- Elevation of top and bottom of individual core drill runs.
- Percentage of rock core recovery.
- Description of rock recovered.
- Thickness of each rock stratum.
- Elevation of rock fractures and cavities.
- Loss or gain of drill water or sudden artesian pressure.
- Name of drilling rig operator.

3.01 INSTRUMENTATION AND DRILLING (CONT'D)

The Contractor shall submit daily time and material records' to the Engineer showing the hours worked by each drill rig. These records shall indicate the driller's name for each rig, regular time and overtime, if any, and all unit price materials used. The records shall be signed daily by the Contractor's representative and the Engineer. One copy shall be made available to the Engineer at the completion of each day's work.

H. DEFINITION OF PAY QUANTITIES FOR INSTRUMENTATION DRILLING

The amount of work to be paid for at the unit prices bid shall be the total lineal feet of borings made and accepted by the Engineer as conforming to the requirements of these Specifications. Payment shall not be made, for frozen or damaged samples, irrespective of the cause. Payment shall be made as follows: (unless otherwise stated)

1. For moving equipment, tools and supplies to and from the job, and between borings, and for any required plant rental, payment for such mobilization will be made in lump sum as stated in the Contract, unless otherwise stated.

2. For core drilling in rock, as described in Item A including the recovery of cores as specified, payment will be made at the unit price per foot stated in the Contract for the actual lineal feet of hole cored and accepted by the Engineer, measured from the depth at which rock was encountered, as determined by the Engineer, to the bottom of the boring.

Fragments of rock, boulders and extremely compact formations which are less than one foot in thickness shall not be considered rock, and payment for such footage will be made at the Contract unit price for soil boring, irrespective of the method of penetration.

3. For installation of standpipe and wellpoint, as described in Item D, including the grouting as specified, payment will be made at the unit price per foot. stated in the Contract.

4. For pressure testing, as described in Item E, payment will be made at the unit price per hour stated in the Contract for those tests accepted by the Engineer. Payment will be made for the total time elapsed from the beginning of the first test at the bottom of the boring, until the completion of the final test, at the rock surface, excluding any time lapse due to equipment failure, or other conditions causing an interruption of continuous testing.

5. For soil borings, as described in Item F, payment will be made at the unit price per foot stated in the Contract for the actual lineal' feet of boring made and accepted by the Engineer.

I. ABANDONED BORINGS

No payment will be made for any boring which has been abandoned by the Contractor before reaching the depth, elevation or condition

3.01 INSTRUMENTATION AND DRILLING (CONT'D)

specified, unless the Engineer approves and accepts the boring 'as being completed. The Engineer may accept a boring which fails to reach the required-depth due to an unusual obstruction which, in his opinion, could not reasonably have been anticipated.

The Contractor shall afford the Engineer the opportunity to measure the depth of any boring and to inspect samples of materials recovered before abandonment and removal of casing and drilling equipment.

J. CLAIMS FOR ADDITIONAL PAYMENTS

The prices quoted by the Contractor in the Proposal shall include costs of all Work for which the Contractor expects to be reimbursed. No claims for extra work of any kind will be allowed except as specifically ordered in writing by the Engineer. All payments to the Contractor will be made on the basis of unit prices quoted and made part of this Contract.

3.02 BORING LOGS AND CALIPER LOGS

Within five (5) calendar days of the completion of the Work, five (5) copies of the boring logs and caliper logs, giving the information required shall be submitted to the Engineer.