APPENDIX C

Solid Waste (Non-Coal) Disposal Plan

Solid Waste (Non-Coal) Disposal Plan

Introduction

The operation and reclamation plan for the solid waste disposal facility that services the Black Mesa and Kayenta Mines is contained herein. The plan was originally presented in a permit application package submitted to the regulatory authority in January of 1981 which resulted in the issuance of Mining Permit AZ-0001. In the process of preparing the plan, Peabody contracted F.M. Fox and Associates in 1981 to evaluate the use of a portion of the J-3 mining pit as a solid waste disposal site and suggest an operational plan for the facility. The final report resulting from that contract was submitted to the regulatory authority as an Attachment to Peabody's original landfill plan (Volume 22, Tab C, 1981-1985 Mine Plan). The Fox report may be referenced as support for the choice of the J-3 area as a suitable landfill site and because the report recommendations were considered when preparing the operation plan. The plan contained herein includes revisions only to the extent that they update the original plan and make it compatible with pertinent information contained elsewhere in this Permit Application Package.

Site Location

The waste disposal site occupies approximately nine acres within the Navajo Reservation, Navajo County, Arizona, and is located approximately 20 miles southwest of the Town of Kayenta. Specifically, the site is situated within the northeast 1/4, Section 33, Township 36N, Range 17E, GMS. The site is centrally located within the lease area, a mined-out strip-mine pit designated as J-3.

The landfill site is located on the divide between two major drainages; Moenkopi Wash and Coal Mine Wash. It is approximately 1 3/4 miles distance from each drainage. Surface drainage is generally away from the landfill site, with the exception of areas along the eastern and western pit walls (see Drawing No. 85400, Map K-9, and Drawing No. 85405). The disposal area consists of a strip mine pit having a rim elevation ranging from 6575 to 6600 feet and an approximate pit-bottom elevation ranging from 6480 to 6525 feet. The majority of the area surrounding the strip mine pit has been reclaimed and supports vegetation consisting of perennial grasses, forbs, and shrubs.

Geology, Hydrology and Climate

The bedrock at the site of the solid waste landfill is the Wepo Formation of the Mesa Verde Group (Upper Cretaceous Age). The Wepo Formation contains the economically recoverable coal on Black Mesa, and removal of the surface mineable coal has created the void or pit used for non-coal solid waste disposal. This formation consists of intercalated sandstones, siltstones, carbonaceous shales, and coal. These units display a great degree of intertonguing, and both vertical and lateral facies changes occur; characteristics consistent with an inner deltaic environment of deposition.

The Wepo Formation was mined to a depth of 100 to 140 feet in the immediate vicinity of the waste disposal area, and the resulting excavation was partially backfilled with 15 to 20 feet of spoil material. The north side of the landfill site was constructed against undisturbed bedrock (Wepo), while the south side of the landfill was constructed against overburden material (spoil) produced by the previous mining activity.

The Wepo Formation ranges in thickness from 200 to 600 feet within the lease area. It is underlain by the Toreva Formation, also part of the Mesa Verde Group. The Toreva Formation contains upper and lower sandstone members, and a middle member consisting of interbedded carbonaceous shales, variegated siltstones, thin coal beds and some poorly sorted, fine to coarse grained sandstones. The lower sandstone member grades downward into a mudstone which conformably overlies the Mancos Shale (Upper Cretaceous Age). The Toreva Formation is approximately 300 feet thick within the lease area. The surface drainage networks in the lease area cover those portions of the Wepo and Toreva Formations with a thin mantle of alluvium which, along with thin colluvial deposits, are the most recent formations on Black Mesa. The geologic setting at the landfill site is summarized in Figure 1.

As previously discussed, the Mesa Verde Group underlies the landfill site and includes, in ascending order, the Toreva Formation, the Wepo Formation, and the Yale Point Sandstone. The Yale Point Sandstone and part of the Wepo Formation have been eroded away and are not present within the landfill area.

Underlying the Mesa Verde Group is the Mancos Shale which, due to an overall lack of porosity and permeability and its thickness in the lease area (approximately 670 feet), effectively prevents hydraulic connection between the localized aquifers in the Mesa Verde

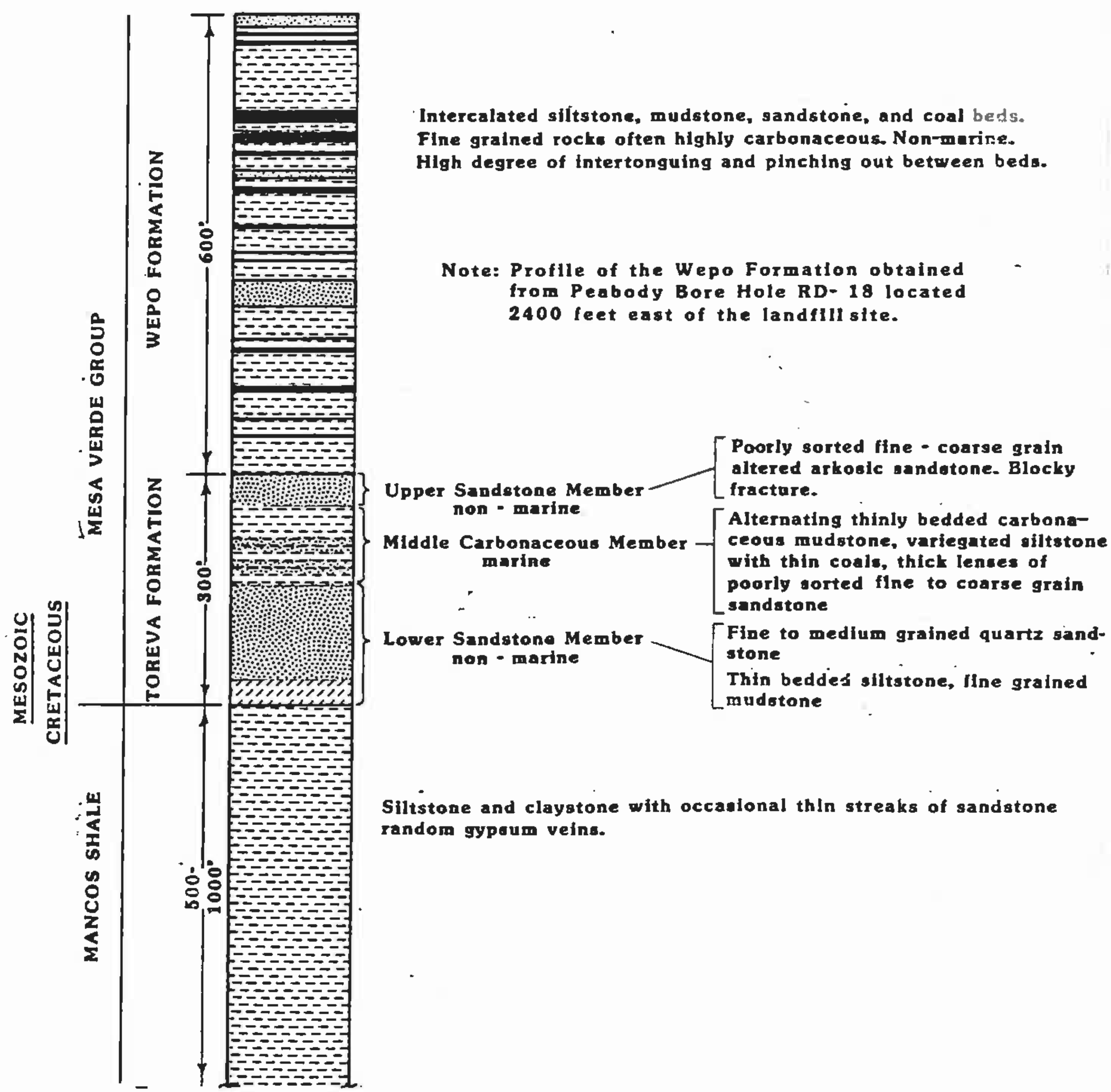


Figure 1. GENERALIZED GEOLOGIC CROSS SECTION

Group and the regional aquifers below the Mancos Shale. The regional aquifers range in depth from 1,100 to 5,000 feet below the surface.

The Wepo Formation (the surficial bedrock at the landfill site) consists of a thick sequence of interbedded and laterally discontinuous shales, mudstones, siltstones, sandstones, and coal beds. The capability of any particular porous and permeable unit in the Wepo Formation as a regional aquifer is very limited due to a lack of vertical hydraulic communication (except for minor fracture communication) and the lack of lateral continuity. The total thickness of sandstone in the formation is small relative to the amount of mudstone, siltstone, and coal.

The sandstone units in the Toreva Formation, generally in the upper and lower parts of the Formation, may have a capability as local or regional aquifers, depending on their degree of lensing and intertonguing with the shales, mudstones, and siltstones. The ground water quality in the parts of the Mesa Verde Group where wells have been completed is generally poor, limiting suitability for drinking, irrigating, or livestock use (Chapters 15 and 16).

Ground water, where found in the Mesa Verde Group, is both under water-table and confined states. Artesian conditions frequently occur in these formations away from the outcrop ringing the Mesa with unconfined conditions occurring near the Mesa rim. Due to the high degree of sandstone bedrock intertonguing, water levels may be variable from place to place. Perched water tables may exist in the Wepo Formation. In areas where the contact between the basal sandstone of the Toreva Formation and Mancos Shale is exposed, ground water discharges as springs. Ground water movement in the Mesa Verde Group is generally in a westerly to southwesterly direction in the Black Mesa area. Structural deformations, synclinal and anticlinal, within the Mesa Verde Group affect ground water flow areally. Recharge to the Mesa Verde Group is from both rainfall and snowmelt. Conduits of recharge to the sandstone aquifers in the group are represented by permeable or fractured and jointed units exposed at the surface, particularly in areas of extensive clinker and along the edges of the Mesa and in the valleys where recharge can occur through stream beds.

Aquifer tests performed on the lease indicate transmissivity values in the Wepo Formation range from .1 to 1,990 gallons per day per foot. Storage values range from 10^{-4} to 10^{-5} which are indicative of confined conditions. The wells that were tested ranged in total depth from 220-350 feet and have multiple perforated intervals opposite the more permeable zones in the Wepo Formation.

Ground water quality in the Mesa Verde Group and the overlying alluvium is generally poor due to high TDS, sulfate, and alkalinity values. Water in the Mesa Verde Group can be classified as a calcium-sodium bicarbonate or calcium-sodium and calcium-magnesium sulfate water (Chapters 15 and 16). Water in the alluvium can be classified as a calcium-magnesium sulfate, or calcium-magnesium bicarbonate.

The potential for the landfill to impact the ground water systems in the lease area and beyond is extremely low. The support for the above statement is summarized as follows:

1. The bedrock units are discontinuous laterally and vary in composition with depth. This creates a situation of minimal hydraulic connection horizontally and vertically between individual permeable beds.
2. The potential for leachate generation will be limited by site conditions; principally low annual precipitation rates, and low moisture infiltration rates.
3. The Mancos Shale effectively seals off any hydraulic connection between the Mesa Verde Group and the regional aquifers below the Mancos.

A number of test holes and ground water monitoring wells were placed in the vicinity of the site in order to obtain geologic and hydrologic data originally required for the 1981-1985 Mine Plan. Although this information was used for characterizing the site in general, five additional test holes were drilled in March of 1981 by F.M. Fox for the purpose of obtaining site specific data to confirm the existing subsoil and bedrock characterization data and to obtain additional permeability data. The holes were logged by a qualified soils engineer at the time of drilling. All test holes were advanced with a 4 1/2-inch rotary bit drilling with air. Samples of the cuttings were selected for laboratory classification and verification of the test hole logs.

Constant head "stand pipe" and packer type permeability tests were conducted in all test holes drilled at the site. These tests were conducted to determine mass permeability information and the permeability of individual soil or bedrock types. All tests were run for a sufficient time period to allow permeability measurements to be made under nearly saturated conditions. Refer to Table 1 for a summary of the field permeability test results.

The bedrock at the site consists of interbedded shales, siltstones, sandstones, and coals.

TABLE 1

SUMMARY OF FIELD PERMEABILITY TEST RESULTS

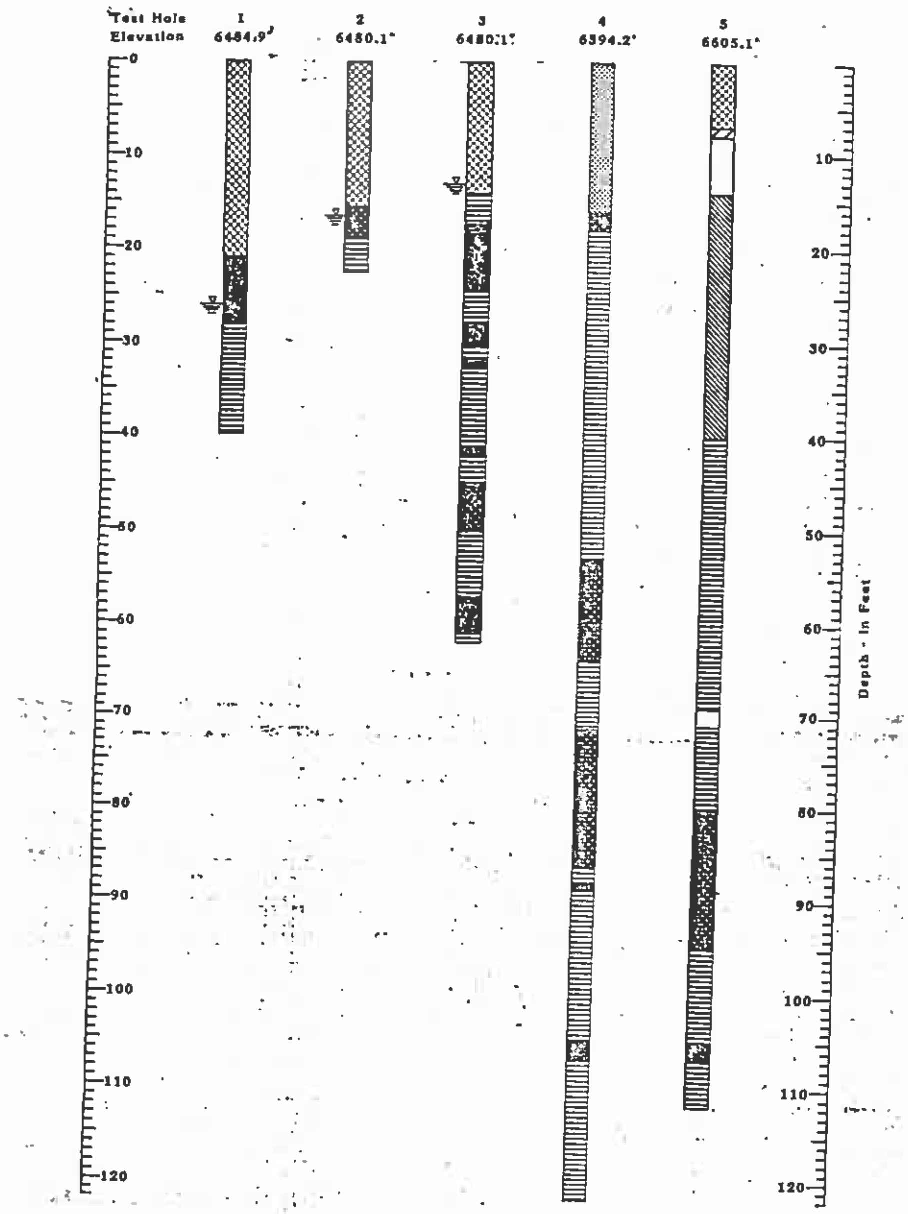
Test Type	Bedrock Type	Interval (ft.)	Test Type	Permeability (cm/sec)
TH1	Shale	35-40	Packer	1.0×10^{-7}
TH2	Spoil	2	Stand Pipe	2.3×10^{-5}
TH3	Carbonaceous Shale and Coal	24-29	Packer	2.7×10^{-5}
TH3	Shale	14	Stand Pipe	1.7×10^{-7}
TH3	Shale, Coal, Sandstone	38-62	Packer	3.4×10^{-6}
TH3	Spoil	2	Stand Pipe	6.6×10^{-3}
TH4	Sandstone (fine grained)	67-81	Packer	1.0×10^{-5}
TH4	Shale, Coal, Sandstone	85-122	Packer	1.8×10^{-6}
TH5	Sandstone (coarse grained)	26-42	Packer	1.5×10^{-4}
TH5	Shale, Coal, Sandstone	67-112	Packer	3.1×10^{-6}

The strata vary with depth and are frequently discontinuous across the site. Refer to Logs of Test Holes (Figure 2) and subsurface strata section (Figure 1) for further information. Field permeability tests conducted at the site indicate varying permeabilities for the different strata encountered (see Table 1).

Test Holes 1, 2, and 3 (see Plate l, Attachment 1) were drilled along the pit floor. Logs of these test holes indicate approximately 15 to 20 feet of spoil material have been placed in the pit. The constant head in-situ permeability tests performed in the spoil material (mixture of shale, sandstone, siltstone, and coal) indicate permeability coefficients of 2.3×10^{-5} cm/sec and 6.6×10^{-3} cm/sec. In-situ permeability tests conducted in the underlying strata indicated permeability coefficients on the order of 10^{-5} to 10^{-6} cm/sec for the sandstone, carbonaceous shale, and coals, and 1×10^{-7} cm/sec permeability coefficients for the underlying shales. Water was encountered in all three test holes in the pit bottom with water elevations ranging from 6460.1 to 6467.1; approximately in the same elevation of the shale with the underlying shale being dry.

In addition to the three test holes placed along the pit floor, two test holes were placed along the northern edge or highwall side (Plate 1, Attachment 1). The two test holes were drilled to a depth of 122 feet and 112 feet. Two types of sandstone encountered during drilling exhibit the highest permeabilities of the bedrocks tested. One sandstone type is fine grained with a permeability coefficient of 1.0×10^{-5} cm/sec; and the other sandstone type (found only in test Hole 5 between 14 and 40 feet below the top of the highwall) is coarser grained and exhibiting a permeability of 1.5×10^{-4} cm/sec. Mass permeability tests conducted over large test intervals involving several bedrock types indicate an average permeability of 2.8×10^{-6} cm/sec.

Water was not encountered at the time of drilling in either test holes 4 or 5. However, the bore holes were not held open to allow for future monitoring of water table conditions. Test hole 4 is located directly between MW86 and MW90, approximately 100 feet west of MW86 and 240 feet east of MW90. Test hole 5 is located approximately 300 feet northeast of MW86. From surveyed elevations and water table depths obtained in January 1981, it was established that the water level elevation is 6497.01 for MW90 and 6479.47 for MW86 (MW86 and MW90 are located 340 feet apart). As previously stated, test holes 4 and 5 were advanced to a bore hole bottom elevation of 6471.2 and 6491.1, respectively, without encountering ground water. These site specific ground water conditions (variable water levels) are consistent with the general hydrologic conditions characteristic of



LEGEND

- Spoil, mixtures of SHALE, SANDSTONE, SILTSTONE and COAL.
- COAL
- SHALE with interbedded SANDSTONE and SILTSTONE, small coal lenses (< 1/2), slightly moist to moist, hard to very hard, grey
- SANDSTONE BEDROCK, fine grained, silty, slightly moist to moist, very hard to extremely hard, grey
- CLAYSTONE BEDROCK, medium moist to moist, medium hard, yellow brown to brown
- CLAY, medium moist, medium stiff, brown to grey (CL)
- SAND, silty, slightly moist to medium moist, medium dense to dense, yellow-brown to red brown (SM)
- SANDSTONE BEDROCK, medium grained, slightly moist, very hard, yellow brown

NOTES:

1. All test holes drilled with air with rotary drill rig between 3/23/81 and 3/26/81.
2. Water level at time of drilling.

Figure 2. LOGS OF TEST HOLES

existing at the landfill site location have very limited or no hydrologic connection.

While the five F.M. Fox test holes were valuable for obtaining permeability information, they were not left open long enough to define actual water table elevations. To check this assumption, three additional test holes were drilled by Peabody Coal Company in June of 1981. These holes were located at the present pit bottom of the proposed landfill, approximately on the east and west ends, with one drilled near the middle of the pit. These holes showed a variable depth to water from the present pit bottom when checked three days after drilling; however, they showed a consistent elevation of local water table, between 6470 and 6475 feet. This compares reasonably well with the water level in MW86. The closest water to the surface of the pit bottom was 8.65 feet in depth, on the west end of the pit.

Some of the shallow ground water could be attributed to the 3 to 4 feet of standing surface drainage water that was in the pit prior to backfilling of the pit in 1980. The presence of this water does not appear to preclude the use of the pit as a landfill.

A complete discussion of the climate on Black Mesa, Peabody's meteorological monitoring network, and lease area specific weather data is contained in Chapter 11.

Landfill Design

The site has direct access from a well-maintained paved roadway running along the western boundary. An unpaved road presently extends from the paved road to the western portion of the strip mine pit. A ramp has been constructed that extends into the pit bottom.

The operational life of the landfill will coincide with the life of mining activities which are scheduled for approximately 25 years. Based upon the waste volume calculations, only 527 yd^3 of uncompacted waste materials will be disposed of each month. Assuming a final in-place density (compacted) of 740 lbs/yd^3, a total volume of 42,730 yd^3 of refuse will be deposited in the strip mine pit which can accommodate approximately 420,000 yd^3 of refuse.

The results of geologic and hydrologic investigations, soils, and waste analyses, aquifer tests and climatology considerations indicate a low potential for the proposed landfill to impact the ground water systems in the lease area and beyond. Based on these facts, no leachates should be generated, and lining of the pit with a low permeable material was considered unnecessary. The soil required for the landfill construction is obtained from the existing spoil area constituting the south wall of the pit. Specific locations of excavations into the spoil wall will be determined in the field by a qualified engineer.

The landfill site will be constructed using the area fill method. In general, incoming waste materials will be deposited at designated areas of the strip mine pit bottom to create a working face. The waste will be spread on the working face and subsequently compacted. Soils required for weekly and final cover are obtained from the existing spoil material located along the southern wall of the pit. The placement of incoming refuse will generally progress from east to west. The specific filling plan and the sequence of operation are discussed in the Landfill Operation section.

Upland surface drainage controls have been designed in order to minimize water inflow directly into the pit bottom. The only moisture to enter the landfilling area will be that amount of precipitation falling directly into the pit itself.

Because the majority of landfill activity occurs within the pit, windblown trash has not been a problem. Windblown trash escaping from the pit will be periodically collected and returned to the pit as necessary.

Landfill Operation

A number of site development features were constructed. Construction activities include impoundments to receive water from overland flow, a retention/evaporation pond capable of accumulating that amount of precipitation falling directly into the pit itself, and an access road approximately ten feet above the pit floor along the spoil wall. Design plans and calculations for each required pond are presented in Chapter 6, Attachment H (i.e., Pond LF-1, LF-2, and LF-3).

The bottom of the pit has been prepared prior to refuse disposal. Spoil material has been placed in the pit bottom so that runoff will flow westerly along the pit floor and northerly along the highwall before going into the retention/evaporation pond.

Access will be off a well-maintained paved roadway running along the west border of the landfill. An unpaved road extends from the paved road to the landfill. A ramp extending into the pit bottom will have a downhill grade less than 10 percent and a minimum road width of 24 feet to accommodate two-way traffic.

Waste materials accepted at the site will be limited to individual household trash, packaging wastes, and specified mining wastes such as scrap metal, air cleaners, drained oil filters, oily rags, empty bulk oil drums, and assorted packaging and container wastes. Placement of non-coal wastes within eight feet of any coal outcrop or coal storage area is prohibited. No chemical wastes, radioactive materials, sludges, liquids, or any type of hazardous waste will be disposed of at this facility. A permanent sign will be posted listing nonacceptable wastes for disposal. Additional signs will be placed in the pit to direct vehicles to dumping points.

The disposal lifts will begin in the east central portion of the strip mined pit and progress in a westerly direction until it joins with the incoming access ramp. After these series of lifts are completed and two feet of fill material have been placed on top of the refuse material and compacted, a new series of lifts will begin at the eastern end of the pit and again progress towards the west end of the pit (refer to Figure 3).

Incoming refuse vehicles will approach the working face along the access road extending to the base of the pit and along the spoil wall. The working face to be developed will be a minimum of 30-foot wide and will be constructed from the access road in a northerly direction terminating at the pit highwall. Each individual lift is then oriented north-south. The refuse lift will have an average height of 8 to 10 feet, and the working face will slope approximately 25 degrees. The incoming waste is unloaded from the top of the access road onto the working face, spread by a dozer into approximately two-foot layers and compacted by running the dozer over the last layer. The dozer then removes soil from the spoil area and applies six inches of top cover weekly. Two feet of top cover is then applied upon completion of each lift.

The majority of wastes generated at the site are non-putrescible and will not contribute to problems with the vector control.

Measures which will be taken to control potential vectors include the covering of the wastes, fencing to keep out large animals, and prevention of water ponding in the fill area.

Signs will be posted which state that no trash burning will be allowed. If a fire occurs

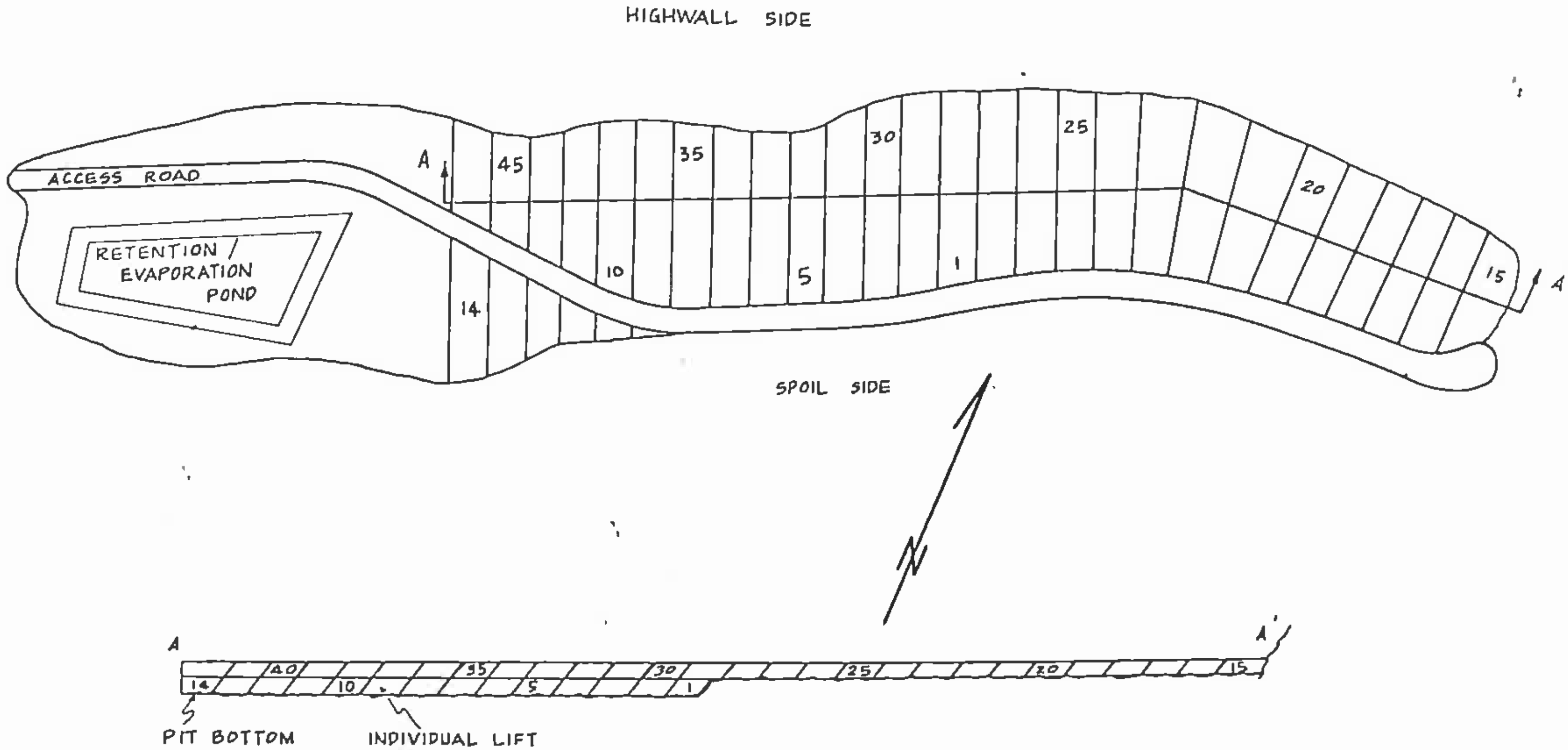


Figure 3. OPERATIONS SEQUENCE PLAN

at the landfill site, it will be controlled by application of a spoil material cover. Spoil material stockpiled adjacent to the site will be used for this purpose. All equipment operators keep working fire extinguishers on their machines which may also be used to control small fires. Range fires, should they be ignited, will be controlled by standard range fire control techniques.

Dust resulting from landfilling operations will be controlled by wetting down the access roads and operational areas with water. The wetting will be done daily or as deemed necessary by the landfill supervisor.

The landfill will be open five days a week, 7:30 a.m. to 5:30 p.m., except on holidays.

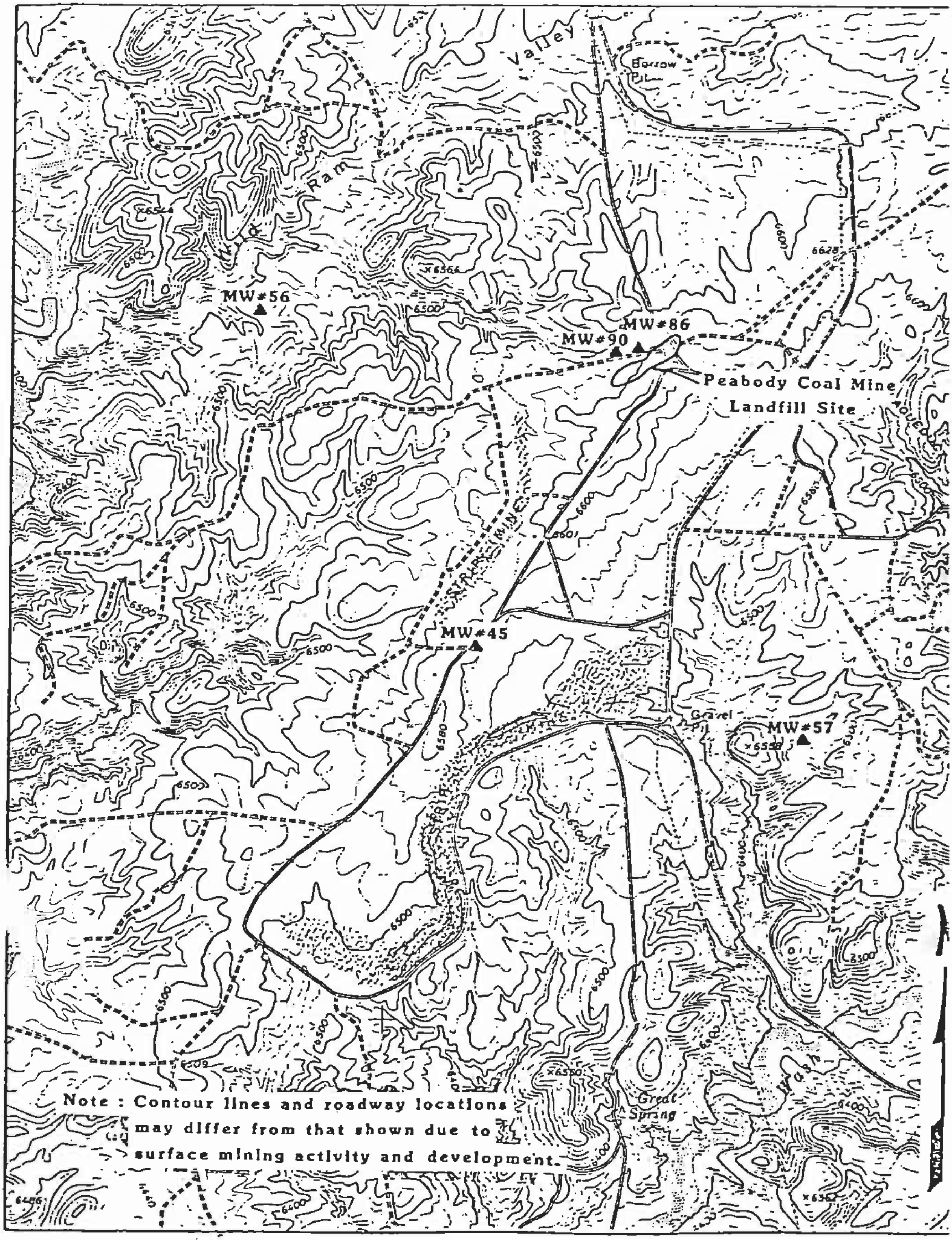
Environmental Monitoring

Ground water quality in the Mesa Verde Group and the overlying alluvium, although highly variable, is generally of limited use for drinking, irrigation, or livestock watering due to high total dissolved solids, sulfate and alkalinity values. Water in the Mesa Verde Group can be classified as a calcium-sodium sulfate water. The variability in water quality can probably be attributed to the limited hydraulic connection between permeable units comprising the aquifers.

As previously indicated, the hydraulic conductivity between water bearing units is limited geologically (i.e., generally by anticlines, synclines, and monoclines, and specifically by noncontinuous interbedded sandstones, siltstones, coals, and shales).

Water quality in the vicinity of the landfill site will be observed by monitoring five existing monitoring wells. The five existing wells, MW-45, 56, 57, 86, and 90 were completed during 1979 and 1980 and are sampled according to provisions outlined in Chapter 16, Hydrological Monitoring Program in the 1981-1985 Mining Plan. All monitoring wells are located within a one mile radius of the site and are shown on Figure 4. The absence of leachate found within the landfill mass itself will be verified by observing three monitoring wells to be installed following landfill construction and placement of the final backfilling and reclamation materials.

All monitoring wells are installed in the Wepo Formation to maximum depths ranging from 252 to 347 feet and perforated where the drillers log indicated first ground water was



Source: U.S.G.S. Great Spring Quadrangle (Topo 7.5 Series) Scale: 1"

Figure 4. WATER QUALITY MONITORING WELL LOCATIONS

encountered and opposite the more permeable rock units indicated on the geophysical logs. The wells are gravel packed with peak gravel and sealed at the surface with a concrete plug to prevent surface water infiltration.

The five monitoring wells were sampled on a quarterly basis to establish baseline water quality. Thereafter, water quality parameters have been monitored on a semi-annual basis. Water quality parameters analyzed for are indicated on Table 2. Two additional parameters, toluene and dissolved organic carbon, will be determined because of the deposition of drained oil filters in the landfill. Analyses for pH, conductivity, and temperature as well as a water level are performed in the field at the time the water samples are collected. All sample collection, preservation, and analyses is performed in accordance with accepted EPA procedures. Within six months of detection of leachate, or other liquid pollutants, Peabody will develop, submit to OSMRE and implement, following approval, a plan containing appropriate mitigation measures.

Due to a number of factors, i.e., low refuse moisture, relatively low organic content and low refuse volumes, decomposition and subsequent methane gas generation at the site will proceed at a very slow rate. The methane gas pressures that may develop with the landfill mass will be relieved by venting the gases into the atmosphere. Venting will be accomplished by the installation of three interior wells (see Plate 3, Attachment 1). Details pertaining to monitoring vent well construction are indicated in Figure 5. The vent wells will be installed after reclamation down to the base of the landfill mass. These wells will also be utilized to confirm the presence or absence of leachate. The monitoring frequency will be on a semi-annual basis. No methane gas monitoring has been recommended at the site. However, no permanent building or subsurface utility line will be constructed within 1000 feet without first checking for methane gas migration.

Landfill Closure and Reclamation Plan

The life expectancy of the solid waste landfill is approximately 25 years. Upon the completion of refuse placement, a final cover of spoil and topsoil material will be applied in accordance with the Minesoil Reconstruction Plans contained in Chapter 22 (Volume 11). The final lifts will be placed at the site in such a manner that the reclaimed elevations result in a configuration which insures that water cannot pond directly above the area.

The landfill is included in the current disturbance area statistics for the leasehold (Volume 11, Chapter 22, Page 21). It therefore has been included in the topsoil liability

TABLE 2

Water Quality Parameters to be Analyzed as Part
of the Hydrologic Monitoring Program

Total Hardness	Phosphate
pH	Turbidity
Dissolved Oxygen (stream samples only)	Total Suspended Solids (TSS)
Biological Oxygen Demand (BOD)	Total Dissolved Solids (TDS)
Chemical Oxygen Demand (COD)	Boron
Acidity	Cyanide
Conductivity	Manganese (Dissolved)
Alkalinity	Mangangese (Total)
Bicarbonate	Barium
Calcium	Arsenic
Magnesium	Selenium
Sodium	Mercury
Chloride	Chromium
Fluoride	Copper
Sulfate	Lead
Aluminum	Silver
Potassium	Zinc
Silica	Antimony
Iron (Dissolved)	Cadmium
Iron (Total)	Molybdenum
Ammonia N	Nickel
Nitrate N	Vanadium
Nitrite N	Temperature
	Toluene
	Dissolved Organic Carbon

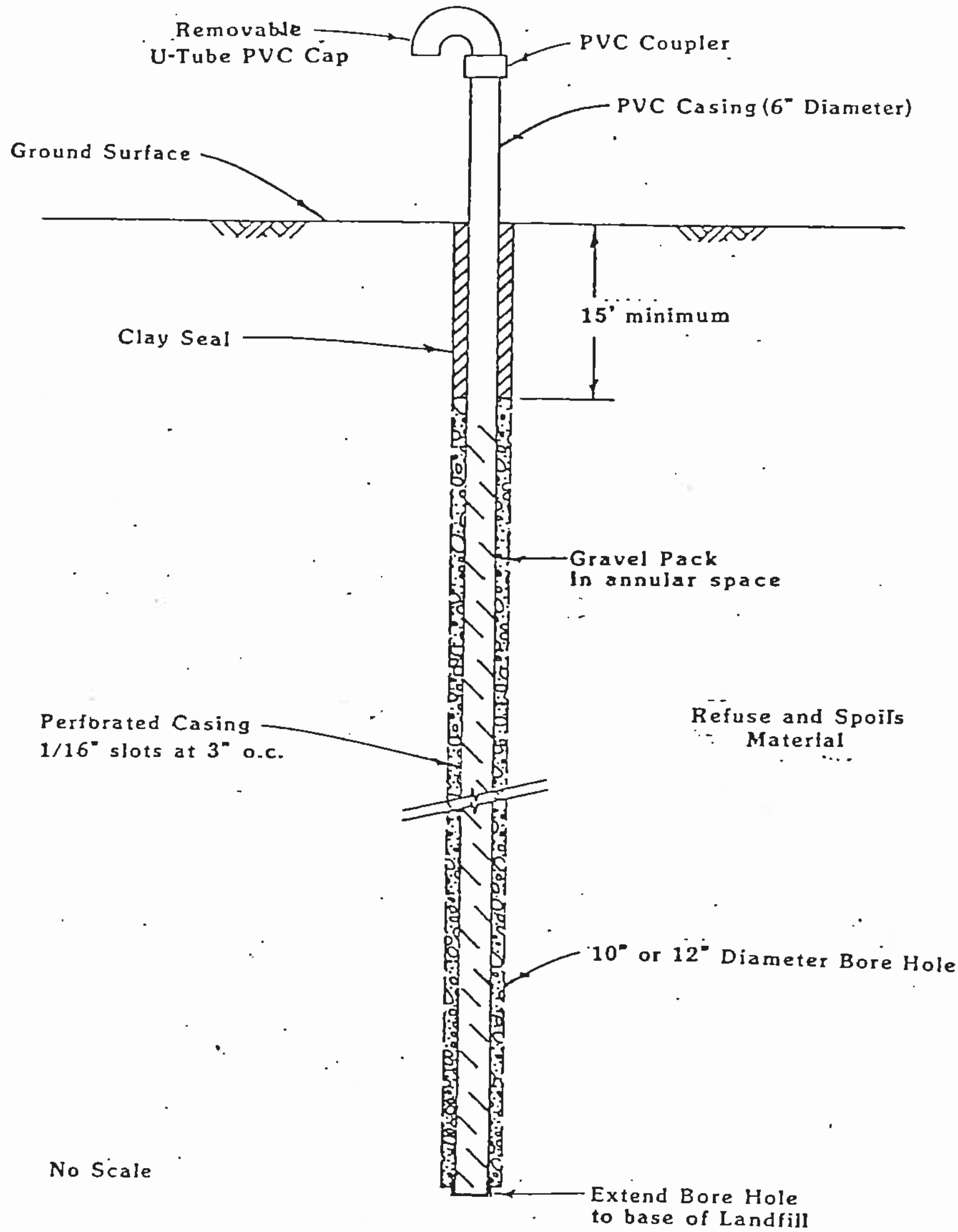


Figure 5. TYPICAL CROSS SECTION OF METHANE GAS VENT WELL

acreage. The J3-2 topsoil material stockpile (Volume 11, Chapter 22, Page 5) is the source for the topsoil material needed to reclaim the site.

Reclamation will begin immediately following the completion of refuse placement to encourage rapid establishment of a minesoil and perennial vegetation cover. This is important with regard to minimizing the amount of infiltration of precipitation into the landfill mass. The revegetation and associated methods (mulching, fertilization, and stabilization) will be consistent with those presented in the Revegetation Plan (Volume 11, Chapter 23).