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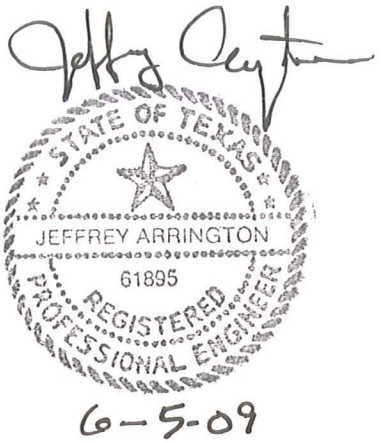

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PART 3 – SITE DEVELOPMENT PLAN - §330.63

PART III

SITE DEVELOPMENT PLAN

3.1 FACILITY DESIGN - §330.63(B)

3.1.1 FACILITY ACCESS - §330.63(B)(2)

A. Vehicular Survey and Traffic Projection

An estimate of the number, size, and maximum weight of vehicles expected to use the site daily has been calculated over a 6-month period. This estimate is presented as follows:

Number	Size	Maximum Weight (lbs.)
37	Hoist and Haul Truck	16,450
12	2 ½ Ton Truck	17,250
13	Compactor Truck	38,300
14	Pickup	4,000
7	Dump Truck	25,500
3	5-Ton Truck	28,000
5	1 ½ Ton Truck	8,000
3	¾ Ton Truck	7,000
3	Tractor Trailer	38,000

The estimated number of vehicles to use the site daily is 97. The estimated number of vehicles to use the site during the expected life of the facility is 640,200.

3.1.2 SANITATION (CONTAMINATE SURFACE WATER HANDLING)

All contaminated surface water will be stored temporarily with small earthen berms in areas protected by the liner. A detail of the small earthen berms and how they will be used in the temporary storage areas is shown on Sheet 13 of 16, Sequence No. C12. A vacuum truck shall be utilized to remove contaminated surface water. The contaminated surface water will not be spread by irrigation during compaction of wastes. It will not be spread on top of the completed landfill. Provision has been made with the Bell County W.C.I.D. No. 1 Wastewater Treatment Plant for acceptance of the contaminated surface water and leachate removed from the landfill, pending analytical results to be done once to be accomplished when contaminated water and/or leachate is produced. A letter of from the W.C.I.D. No. 1 indicating conditional acceptance is included in Appendix II.

3.1.3 WATER POLLUTION CONTROL (DRINKING WATER PROTECTION)

There are no water supply wells in the vicinity of the landfill. Fort Hood receives its principal water supply from the City of Gatesville which is from Lake Belton on the Leon River. North Fort Hood and surrounding communities also rely upon the City of Gatesville for their water supply which is water from Belton Lake. The Travis Peak occurs at an estimated depth in excess of 400-feet at the site. Separating the Travis Peak Formation from the bottom of trenches at the proposed landfill, is an estimated thickness of 400-feet of primary strata including the Paluxy and Glen Rose Formations. Although the Paluxy is a major aquifer in other areas, its occurrence at the site is at its southern margin of deposition where its thickness feathers to 7-feet. It occurs as a remnant isolated by erosion and not hydraulically connected to the water producing portion of the formation. The Glen Rose Formation comprises the remainder of the strata overlying the Travis Peak. It is a dense, finely crystalline, chalky, and variably argillaceous limestone.

3.1.4 ENDANGERED SPECIES PROTECTION

There are no endangered or threatened species in the vicinity of the proposed landfill. The basis for this conclusion is found within the report entitled "Ecological Baseline Report, Fort Hood, Texas," dated July 25, 1979, prepared for Fort Hood by Espey Huston and Associates. This report is incorporated within the Environmental Impact Statement for Fort Hood.

The United States Fish and Wildlife Service was requested to provide an opinion on the impact of the operation of the proposed sanitary landfill site on endangered or threatened species. Their letter states that there are no threatened or endangered species existing at the proposed site, and that it is their opinion that the proposed project will not impact any of these species.

3.2 FACILITY SURFACE WATER DRAINAGE REPORT - §330.63(C), §330.303

Applicant will not discharge pollutants into waters of the State or United States. Applicant will not discharge dredged/fill material into the waters of the United States. Applicant will not have nonpoint source pollution of waters of the United States. The proposed site is well outside the limits of any surface waters. The proposed construction (excavated for area fill) will limit the possibility of discharge to surface waters.

3.2.1 SURFACE DRAINAGE CONTROLS

The peak discharges shown on drainage area maps and used for the design of the proposed drainage ditches were developed for a 25-year storm event using the rational method as described in the TXDOT Hydraulic Manual. Runoff volumes were calculated for a 24-hour 25-year storm event using SCS method TR-55.

The Fort Hood Municipal Landfill is located in a remote undeveloped region of the Fort Hood Military Installation in Coryell County. The landfill site is situated on a local ridge that eliminates run-on from areas outside the permit boundary. Natural drainage patterns from this site prior to landfill development are represented on the Existing Topographic Map - Drawing C1A and the Existing Drainage Area Map - Drawing C1 located at the end of this section. Stormwater runoff from the site is divided into five drainage areas A-E. Runoff from areas C,D and E exit the site along the eastern boundary and combine in a natural drainage swale approximately 400-500 ft from the permit boundary. Drainage area A exits the site along the eastern boundary and is collected in an existing swale that slopes to the east and north of the site. Drainage area B exits the site along the north boundary into an existing swale.

Runoff calculations for existing conditions are presented on calculations 3.2-2 to 3.2-6. 3.2-2 presents peak discharges for drainage areas A-E. 3.2-6 presents runoff volumes for each of the five drainage areas. Existing conditions drainage calculations are also summarized on Drawing C1. The analysis of existing drainage patterns indicates the following:

Boundary	Areas	25 yr Discharge (cfs)	Runoff Volume (ac-ft)
East	**A**	**114.7**	**29.19**
West	**C,D,E**	**106.1**	**31.91**
North	**B**	**22.6**	**6.72**

Interim Drainage Conditions

Interim drainage conditions are depicted on Drawing C2 - Interim Drainage Area Map. This drawing along with the calculations represents stormwater runoff conditions during active development of the landfill at present. During this phase of development drainage ditches have been constructed for the landfill sectors currently being filled and for those already completed. Calculations 3-2.3 and 3-2.7 represent peak flows for the 25 year rainfall event as well as runoff volumes for the 24 hour 25 year event.

Proposed Drainage Conditions

The proposed drainage system for the final grades of the Fort Hood landfill is represented by Drawing C3 Drainage Area Map. The landfill is divided into 5 drainage areas A, B, C, D, and E with each drainage area divided into subdrainage areas. These drainage systems were designed to carry the flows of each subdrainage area from a 12-foot ditch to an 18-foot drainage ditch within an existing system. Velocity reducer devices (detailed on Sheet 13 of 16, Sequence No. C12) were included at locations shown on drawing C3 where velocities exceed permissible velocities for grass lined ditches.

Proposed conditions drainage calculations were performed for each drainage area that include peak discharge and runoff volumes. These values are summarized below for each permit boundary. Detailed calculations are contained at the end of this section.

Boundary	Areas	25 yr Discharge (cfs)	Runoff Volume (ac-ft)
East	**A**	**92.88**	**29.45**
West	**C,D,E**	**159.58**	**34.16**
North	**B**	**15.76**	**2.90**

The total runoff volume from the site under existing conditions is estimated to be 67.8 ac-ft. Proposed conditions runoff volume at final grades is estimated to be 66.5 acre-feet. The peak 25 year discharges for proposed conditions decrease slightly along the east and north boundaries but increase approximately 53 cfs along the west boundary. The increase is only 26 cfs between interim and proposed or final drainage conditions. This increase in discharge will not adversely impact the surrounding area because the permitted landfill site is located inside Fort Hood in an undeveloped region with well defined drainage swales that can accommodate the additional flows.

The proposed drainage system at the Fort Hood landfill will not significantly alter existing drainage patterns or cause adverse impacts off site as the facility is surrounded by US government owned land that is part of Fort Hood Military Installation.

Contaminated Stormwater

Contaminated stormwater runoff is stormwater that has com into contact with solid waste. The volume of contaminated water is minimized by constructing a soil berm around working face. Precipitation falling within the working face berm will be contained and allowed to evaporate. The working face berm containment area has been sized to contain a 24 hour 25 year storm with freeboard. Calculations are included at the end of this section. If excess water accumulates in the containment area it will be removed by pumping into a tanker truck and discharged into the sanitary sewer on site.

Erosion control

As the landfill sectors achieve final grades grass will be established over the soil cap to prevent erosion. As landfill sectors are filled up to existing grades and above grade additional interim measures will be implemented to prevent excessive loss of soil cover material. All above grade fill areas with intermediate cover will also be seeded to establish grass cover. This will minimize soil loss. During active above grade landfill operations additional erosion protection measures will be used such as silt fences along the toe of fill slopes. Additional measures such

as rock berms or rock riprap may be used at points or discharge from the site. Drawing C-3A provides details for these and other erosion protection methods. Grass will also be established within the roadside ditches to further minimize soil loss and maintenance of ditch sections.

The Universal Soil Loss Equation was used to estimate the soil loss for the steepest slopes proposed at the landfill. Based on this calculation the maximum soil loss anticipated at the landfill is 2.21 tons per acre for the 20 percent slopes. Based on this estimate the proposed slopes will have acceptable soil loss amounts as designed without the need for diversion berms or downchutes.

3.2.2 PROTECTION FROM THE 100-YEAR FLOOD

The Federal Emergency Management Agency, Flood Insurance Rate Map[1], indicates the project site to lie outside the 100-year flood. The nearest encroachment of the 100-year flood is within a drainage pathway, tributary to Clear Creek, approximately 1,000-feet east of the northeast corner of the project site.

[1] Flood Insurance Rate Map, Community Panel Number 480768 0306B, Federal Emergency Management Agency, September 30, 1981.

3.3 WASTE MANAGEMENT UNIT DESIGN

3.3.1 PROVISIONS FOR ALL-WEATHER ACCESS

The primary access roadway to be used in the disposal operation is Turkey Run Road, classified as an all-weather, hard-surface roadway. Located at the southern boundary of the proposed landfill site, the two-lane roadway consists of strip paving with no significant roadway restrictions. An estimated total vehicles per day (VPD) on Turkey Run Road is between 5,000 to 6,000 VPD. There is no projected increase for the next 25 years. Turkey Run Road is maintained by Fort Hood.

Interior all-weather roads and the access route to the entrance of the site will consist of a 6-inch aggregate base course compacted subgrade to 100 percent standard density.

Temporary roads will not be used to deliver wastes to the working face from the permanent road system. Permanent roads will be constructed around each Area. Temporary roads will be used until the completion of the construction of the Area and for access to monitoring wells in the areas that have not been completed. Temporary roads will be constructed by compacting the natural soil present, and by controlling drainage, or by topping them with a layer of a tractive material such as gravel or crushed stone. The use of gravel or crushed stone will help minimize mud tracking and aid in dust control. For additional dust control, water trucks will be used for sprinkling roads.

The intersection of Turkey Run Road and the access road are shown in Part 3. The actual gates for admittance into the site are located approximately 50-feet north of this intersection at the entrance to the landfill site. The radius of the access road at the entrance to the landfill site will be 50-feet. The maximum length of vehicles traveling on this entrance road will be 60-feet.

3.3.2 ACCESS CONTROL AND FENCING

The long-range operation of the proposed sanitary landfill will be divided into three phases. Each phase will include one-third of the entire permitted facility. The first two-thirds of the entire site is presently enclosed by a minimum 7-foot high chain link fence or an equivalent metal fence. Once the landfill is in operation, the fence will deter the entry of wild animals, protect the public from exposure to potential health and safety hazards, and discourage unauthorized entry or uncontrolled disposal of materials. Access to the site during times when the operators are not present will be prevented by means of a new 22-foot wide, 6-foot high, double swing gate with lock.

As the Phase I area becomes filled to capacity, additional fencing as previously described, will be constructed to encompass the Phase II disposal area. Phase III will be fenced in a similar manner at the appropriate time.

In the future, the internal fences between the Phases may be taken down as the area is returned to its native conditions. All boundary line fences will be maintained at all times.

3.3.3 ENGINEERING CONSIDERATIONS

A. Landfill Method

The proposed method of landfill operation will be a combination of trench and area fill method.

B. Wet Weather Provisions

All-weather access to the site will be provided by means of all weather roads. During the wet weather period, the site operator will designate the site location to deposit wastes. The site operator is also responsible for providing the exact location and the surface design of access road to be used during the wet weather period.

C. Special Handling Wastes

The landfill will not have specified areas for the disposal of special waste, except for the proposed special waste trench for depositing construction debris that has been tested to be non-hazardous according to the toxicity characteristic leaching procedure. The list of Special Wastes that are accepted at the Fort Hood Landfill is contained in Part IV - The Site Operating Plan.

Special Waste Trench Design

The Special Waste Trench was designed according to guidelines obtained from the TCEQ Municipal Solid Waste Division and 30 Texas Administrative Code §§ 330.1-330.341, and in particular §330.331. The trench must have a 3-foot compacted clay liner directly overlain by a flexible membrane liner (FML), a leachate collection system, and finally covered by 4-feet of clay. The composite liner system consists of a 3-foot clay layer overlain with a 60-mil high density polyethylene (HDPE) FML component, overlain with a 12-inch drainage layer ($1x10^{-2}$ cm/sec coefficient of permeability), overlain by a 12-inch soil layer. The liner system must comply with the Soils and Liner Quality Control Plan in conjunction with the TCEQ's Liner Construction and Testing Handbook in Part 4.

The Special Waste Trench is designed with a leachate collection and removal system designed and constructed to maintain less than 30-cm depth of leachate over the liner. To predict the amount of leachate that will be produced in the Special Waste Trench, a U.S. EPA computer program, Hydrologic Evaluation and Liner Performance (HELP), Model 2.05, was used. Parameters pertaining to the geology/soils, climatological data, and solid waste placement, and liner data were used to predict the height of leachate on the liner to verify the slopes were sufficient and to avoid leachate ponding on the liner. It was determined that the leachate would not accumulate in levels greater than 30 cm (12-inches) after using the HELP model. See HELP Runs, Part 3.

At each lateral expansion of the Special Waste Trench is an 18-inch cleanout pipe for each sump for removal of the leachate. Each header pipe shall have a clean out and a cap at the end. As the area of fill expands, the cap will be removed and additional pipe shall be added to expand the header either east or west depending on the direction of expansion. This procedure shall be utilized until the expansion reaches the highest point of the area as shown on drawings C8 to C11 (See Part 3). At this point the area shall be closed to receipt of waste and the pipe plugged.

The special waste shall only be placed to the existing surrounding natural ground surface elevation, with the exception of asbestos-containing waste. Solid waste shall be placed on top of the 4-foot compacted clay layer to reach the final contours as shown on the closure for Area 2 (See Sheet 13 of 16). Inquiries to the TCEQ, Municipal Solid Waste Division, Permits Section resulted in the requirements for the liner system and cover. Mr. Philip A. Spry, P.E. advised that 4-feet of clay cover would be required; however, the 18-inches of topsoil would not be required since the municipal solid waste will be placed on top of the 4-feet of clay, which will ultimately receive a Subtitle D cover system.

Operations of the municipal solid waste section above the Special Waste Trench shall be as described in this permit as directed by the Executive Director.

Placement of the special waste in Area 2 shall begin on the east side and proceed in a westerly direction until the highest point in Area 2 is reached. Placement shall continue upward until the specified elevations are reached. Placement rates will be determined after the demolition debris is accepted for disposal, but as the demolition projects are started, rates of waste placement shall increase accordingly. Rates of waste placement shall be kept separate from the municipal solid waste. Rates of compaction shall be approximately 700 to 800 pounds per cubic yard. The daily cover material shall be placed on the special waste to protect personnel and environment from exposures, to prevent disease vectors, fires, odors, windblown waste, and scavenging. Shipments containing asbestos-containing materials shall be covered immediately with the location noted in the operator's log. Leachate collection and removal, ground-water monitoring,

closure and post-closure care shall be conducted according to sections given in this permit or as directed by the Executive Director. Personnel shall be trained in the safe operations of the Special Waste Trench and in personal protective measures to be taken while working in the Special Waste Trench, and the contingency and cleanup of any accidental spills occurring during the delivery and disposal operations. Personnel shall also be trained in the personal protective equipment to be worn. These items shall become a part of the Site Operating Plan.

A manifest system shall be established to accommodate the special waste disposal shipments. Requests for shipments shall be evaluated and must not be allowed without the authorization by the Executive Director to accept the waste, or not authorized by permit provisions. Upon approval, shipments shall be accounted for and waste shipment control tickets maintained for three years. A written report shall be submitted to the Executive Director no later than the 25th day of the month following the month in which the special waste was received. Reports shall be submitted on forms provided by the TCEQ.

When unexploded ammunition is found on-site, the location will be marked and the Explosive Ordinance personnel will be called at (254) 287-2309 to take charge of the round.

D. Control of Wind-Blown Wastes

Blowing litter will be kept at a minimum by maintaining a small-size working face and covering portions of the cell as they are constructed. Cover material is essential for maintaining a proper appearance of the sanitary landfill. Windblown material which is not contained by the cover material should be contained by a minimum 7-foot high security perimeter fencing. The landfill operator's personnel will cleanup litter periodically during the working day, especially near the close of the day. The litter will be placed on the working face before it is covered.

E. Rate of Waste Deposition.

Design Population	45,000	
Solid Waste Generation	69,607	tons/year (average)
Solid Waste Weight	700	lbs/yd^3 (compacted)
Yearly Volume	198,878	yd^3/year
Daily Volume	652 yd^3	day

The available volume at the proposed site for compacted solid waste is estimated to be 4,548,616 yd^3 (see Calculations, Part 3). Daily cover will occupy some of this volume. The ratio of solid wastes to daily cover material volume usually ranges between 4:1 and 3:1. Using the 4:1 ratio, the volume available for solid waste is 3,411,462 yd^3. The yearly volume of compacted solid waste will occupy 198,878 yd^3. Therefore, the design life of the proposed site is:

$$\frac{2{,}849{,}000\ yd^3}{132{,}100\ yd^3/year} = 21.6 \text{ years}$$

$$\frac{3{,}411{,}462\ yd^3}{198{,}878\ yd^3/year} = 17 \text{ years}$$

Therefore, the design life will be approximately 17 years depending on the volume of solid waste delivered to the site.

F. Subsequent Use of Site

It is anticipated that the disposal site will be returned to native conditions. The site will be seeded with native grasses upon completion of the disposal operations. The selection of such grasses and vegetation will be coordinated with the Land Management personnel located in the Directorate of Public Works.

G. On-Site Cover Material

Both daily cover and final cover material will be obtained from the excavations made at the proposed site. Final cover material will be a clayey soil and have a Unified Soil Classification of SC, CL or CH. The soil borings will be used to determine the depth and extent of the excavations with these soil classifications. The materials will be stockpiled for use as final cover. An estimated 444,214 yd^3 of material are required for the final cover. From the soil borings, the volume of material available which meets the requirements for the final cover averages 11/2-feet over the entire area of the site. The volume of soil available that meets final cover requirements is estimated to be 384,000 yd^3. This will require approximately 60,214 yd^3 of the material which will meet final cover requirements to be provided from an off-site source. When the operation requires, select off-site material may be imported from just south of the proposed site across Turkey Run Road. The USDA-SCS soil survey indicates that the soil source is mapping unit Brackett. The top 3-feet are classified as CL or SC. Before this off-site source is utilized, the operator will provide the necessary laboratory analysis to indicate its suitability for final cover.

The material not stockpiled for final cover will be used for daily cover. The estimated volume of daily cover for the proposed site is 1,137,154 yd^3. From the anticipated excavations, the volume of material available for daily cover is approximately 4,164,616 yd^3 (volume of excavation less volume suitable for final cover). A surplus of daily cover material is expected and will be disposed of off-site of the landfill area, but on Fort Hood property as directed by the applicant.

A constructed 60-mil high density polyethylene (HDPE) liner system is proposed for this site. The construction is detailed in the Soil and Liner Quality Control Plan (SLQCP) in conjunction with the TCEQ's Liner Construction and Testing Handbook in Part 4 of this application. The site operator shall notify the regional office of the TCEQ, of their intent to begin construction of any liner prior to commencement of construction.

The completed liner system will consist of a 2-foot compacted soil layer, overlain by a 60-mil HDPE liner, a 16 ounce geotextile fabric, and a 2-foot protective cover layer of soil and sand material above the 60-mil liner. The 2-foot protective cover layer will consist of 1-foot of drainage layer ($1X10^{-2}$ cm/sec coefficient of permeability), overlain by a 1-foot layer of uncompacted soil. The material excavated from the site will be used, when acceptable. An estimated 444,214 yd^3 are required for the 2-foot protective layer (volume approximately equal to final cover volume).

All stockpiles of soil material will be located along ridges or high points within the site, to avoid conflicts with existing drainage paths. The stockpile for final cover will be kept separate from the remainder of excavations. Adequate volumes of the cover materials will be stockpiled to provide the anticipated cover volumes.

H. Fire Control Facilities

No burning of wastes will be permitted at the sanitary landfill. The use of daily cover will keep any accidental fire confined to a cell that is under construction, from spreading laterally to other cells. All equipment operators will keep a fire extinguisher on their machines at all times. A stockpile of earth shall be maintained within 2,500-feet of the working face for fire suppression also. Should the need arise, the Fort Hood Fire Department will be called to control large fires.

I. Provisions for Compaction

The proposed site will use equipment common to earthmoving operations and equipment designed for the special task of compacting and otherwise handling solid waste. Solid waste will be compacted by the compressive forces developed by the overall massive loading of a landfill machine. The waste will be spread in layers approximately 2-feet deep and then compacted by tracked, rubber-tired, or steel-wheeled vehicles that pass over it 2 to 5 times. A compaction equivalent of 700 to 900 pounds per yd^3 is anticipated.

J. Provisions for Subsidence

The sanitary landfill may settle as a result of waste decomposition, filtering of fines, superimposed loads, and its own weight. If settling produces wide cracks in the cover material, the FML will be exposed which will require additional cover material to be added. The surface will be inspected monthly and soil will be added and graded when necessary. Additional material will be available from the stockpile of excavated material located on-site.

A subsidence equal to 10 percent or less of the depth of solid waste is anticipated. All areas affected by subsidence will be restored to final grades by adding additional cover material and grading.

K. Provisions for Site Inspection and Maintenance

The disposal site will be readily available for inspection of erosion and ponding for 30 years following closure of the site. The inspection will check for erosion, ponding, leachate migration and methane migration. Corrective actions will be taken as necessary. Leachate migration will be monitored by water samples from the monitoring wells on the site. Erosion will be checked by grading the surface, filling depressions, and by planting vegetation on the final surface cover.

Ponded water will be controlled to avoid becoming a nuisance. Measures will be taken to prevent accumulation of water, not only in the waste receipt areas, but also the surrounding areas.

Methane migration is not anticipated to be a problem. The characteristic nature of the soils used in the landfill will allow methane to migrate freely to the surface and disperse to the atmosphere without concentration pockets. A methane gas recovery and venting system has been designed for final closure of each Area, to prevent gas buildup within the covered waste areas. A synthetic membrane will be used in conjunction with a soil cover to cap the waste storage area with the vents located along the top elevations

laterally across the Area. Methane gas monitoring will be done quarterly according to the Methane Monitoring Plan.

Corrective actions will be completed as needed throughout the life of the facility and for 30 years following final closure. A Post Closure Care Plan is provided herein.

L. Protection of Ground-Water

A contour map of the potentiometric surface developed from water level readings obtained on December 7, 1987, was presented as Sheet 1 in the initial permit application. Ground-water data has been obtained from temporarily cased exploratory borings serving as observation wells. Each boring was cored using drilling fluid. Therefore, the top of the zone of saturation cannot be determined while drilling (i.e., level first encountered). To obtain the depth of ground-water, each boring was bailed of all drilling fluids and allowed to stabilize. Water levels were measured periodically and recorded. Table 3, Part 3 is this record. The applicant maintains this tabulation of water levels reflects water table conditions. As such, the pressure at the surface of this saturated zone is equal to atmospheric pressure. No additional hydrostatic head needs to be compensated for at or above this level. In situ materials overlying the water table were examined extensively to determine their adequacy as protection separating solid waste from ground-water. Thirty-two field permeability tests were conducted as discussed in Section III.I.2.e(2). Results are presented in Appendix IV. Additionally, 30 laboratory permeability tests, both vertical and horizontal, were conducted. Results are presented in Appendix IV. Although some laboratory coefficient of permeability values are lower than 1.0×10^{-7} cm/sec, values obtained from field tests were consistently higher. It is believed the results from the field permeability tests more closely represent conditions in the field than do the laboratory tests. Accordingly, the applicant concludes that the naturally occurring barrier of in situ soils does not provide the protection of 3-feet of soil with a coefficient of permeability of no more than 1.0×10^{-7} cm/sec. The applicant proposes construction of a

man-made liner, constructed of synthetic material, to provide compliance with the ground-water protection requirements specified in 30 TAC §§330.200 - 330.206.

M. Soil and Liner Quality Control Plan (SLQCP)

The proposed site will be operated to avoid contamination of the ground-water. A 60-mil high-density polyethylene liner (HDPE) system, or alternate design if approved by the Executive Director, will be used as shown by the enclosed drawings in Part 3. The revised SLQCP in conjunction with the TCEQ's Liner Construction and Testing Handbook is detailed in the Site Operating Plan (Part 4). They include specifications and construction methods.

N. Soil and Liner Quality Control Testing

The applicant will be required to furnish all liner quality control testing. The procedures and sampling frequency are included in the revised SLQCP and Liner Construction and Testing Handbook. Reports and results from the liner quality control testing will be submitted to the TCEQ. A Soil Liner Evaluation Report (SLER) shall be used to report the 2-foot, or the 3-foot soil liner for the Special Waste Trench, and a Flexible Membrane Liner Evaluation Report (FMLER) shall be used to report the installation and Quality Assurance/Quality Control process of the FML. Quality control sampling and testing will be performed by an experienced quality control technician and certified by a registered professional engineer, or an experienced engineering geologist as specified (see the TCEQ's Liner Construction and Testing Handbook - Part 4).

O. Liner Used In Conjunction With Compacted Clay

The applicant proposes to use a 60-mil high-density polyethylene (HDPE) liner system as detailed in this application. The lining will be placed in strict accordance with the revised SLQCP and Liner Construction and Testing Handbook as described in the Site Operating Plan (Part 4). Alternate liner designs, if approved by the Executive Director, shall be installed according to the Alternate Liner Construction Quality Control (CQC)

and Construction Quality Assurance (CQA) Plan submitted with the permit modification or permit amendment.

P. Water Balance

To predict the amount of leachate that is produced in this landfill, a U.S. EPA computer program, Hydrologic Evaluation and Liner Performance (HELP), Model 2.05, was used. Parameters pertaining to the geology/soils, climatological data, solid waste placement, and liner data were used to predict the height of leachate on the liner to verify the slopes were sufficient and to avoid leachate ponding on the liner. It was determined that the leachate would not accumulate in levels greater than 30 cm (12-inches) after using the HELP model. See HELP Runs, Part 3.

Volumes of leachate removed from the leachate collection system along with the measured depths in the leachate collection system, shall be recorded and inserted in the operating record. A long, wooden measuring pole shall be used to measure the level of the leachate on the liner. It shall be lowered down the 18-inch leachate cleanout pipe and obtain a reading on the pole. The amount of leachate will be calculated by using the angle of the side slope and the distance on the pole.

3.4 GEOLOGY REPORT - §330.63(E)

3.4.1. Soils Data

A. Geology Report

1. Physiography

Fort Hood Military Reservation is located in southern Coryell County and a portion of adjoining Bell County, in central Texas. This region lies within the Lampasas Cut Plain District of the Great Plains physiographic province.[2] The Lampasas Cut Plain is a broad, elevated, dissected limestone plateau forming the western border of the outcrop of the Fredericksburg Group. Dissection of this plateau has produced interstream ridges and outliers of limestone supported by the Edwards, Comanche Peak, and Walnut Formations. Flat-lying remnants of the Edwards limestone form a few extensive uplands on the main divides. Local relief can reach as high as 400-feet. The Balcones fault zone borders the district on its eastern edge and roughly conforms to the boundary between the Great Plains and Gulf Coastal Plain physiographic provinces. Drainage leaves the reservation primarily via Cowhouse Creek and Owl Creek, both tributary to the Leon River.

2. General Geology

The general geology of the Fort Hood reservation has been developed from published data; primarily the Geologic Atlas of Texas, Waco Sheet,[3] and Stratigraphy of the Fredericksburg Division, South Central Texas,[4] both published by the Bureau

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[2] Physiography of Eastern United States, Fenneman, 1938.

[3] Geologic Atlas of Texas, Waco Sheet, Bureau of Economic Geology, 1970.

[4] Stratigraphy of the Fredericksburg Division, South Central Texas, Bureau of Economic Geology, 1964.

of Economic Geology. The generalized geologic map, Part 3, shows the subject area underlain by three Lower Cretaceous age formations. From oldest to youngest they are the Glen Rose, Paluxy, and Walnut Formations. The Glen Rose is composed primarily of limestone and marl with some shale and sandy shale. The limestone is often dense, finely crystalline, fossiliferous and gray to tan in color, with marl and chalky limestone common. The Glen Rose has an estimated thickness of 400-feet. The project site is situated at the southern edge of the Paluxy outcrop where it has feathered to a thickness of approximately 7-feet.[5] The Paluxy was deposited in a marginal continental to very near-shore environment. The formation consists of fine to medium grained, gray-brown quartz sand and sandstone interbedded with gray carbonaceous clay shale. The Walnut formation unconformably overlies the Paluxy formation. Sediments of the Walnut are marine in origin, consisting primarily of gray to black calcareous clays, thin bedded limestones, thick chalky nodular limestone and shell aggregates. The formation is extremely fossiliferous. The Walnut in this area is well developed. Five distinct members have been mapped in Bell and southern Coryell Counties.[6] Only the lower three members are represented at the project site. From oldest to youngest they are the Bull Creek, Bee Cave, and Cedar Park Members (see Geology Map and Geologic Atlas of Texas, Waco Sheet, Part 3).

Bedrock is mantled with a thin veneer of residual and colluvial overburden. Overburden of any appreciable thickness is confined to the major stream valleys.

3. Structure

The Lampasas Cut Plain district is a dissected limestone plateau dominated by a southeast dipping monocline. Regional dip in this area is generally east-southeast at approximately 40-feet per mile, decreasing to the northwest to about 15-feet per mile. Abruptly terminating the monocline approximately 26 miles east of the site is the

[5] Depositional Systems in the Paluxy Formation, Bureau of Economic Geology, 1977.

[6] Bureau of Economic Geology, loc. cit.

Balcones fault zone. This is a major structural feature where the strata have been downthrown several hundred feet. No faults have been mapped in the immediate area.

4. Ground-Water

Fort Hood receives its principal water supply from Lake Belton on the Leon River. Ground-Water wells in the North Fort Hood area have been abandoned due to the water being saline. The nearest known ground-water wells are in Gatesville approximately 20 miles north of the landfill. The primary aquifer system used for ground-water is comprised of the Hensell and Hosston Members of the Travis Peak Formation.[7] The Travis Peak Formation is comprised of the basal, Lower Cretaceous sands and has an estimated thickness of 200-feet in the study area. The Travis Peak directly underlies the Glen Rose Formation and occurs at a depth in excess of 400-feet at the site. There are no known wells developed in the Travis Peak in the vicinity of the study area.

B. Site Conditions

1. General

Subsurface conditions at the subject 154-acre site have been investigated with 35 continuously sampled core borings (See Erase Drawings, Part 3; Appendix IV for locations). The specific site is situated upon a relatively flat surface ridge supported by the three lower members of the Walnut Formation. Individual members were not identified at the site. Continuous core borings to a depth of 50-feet and spaced on approximately 500-foot centers defined the stratigraphy of the site in detail. See Soil Conservation Service Soil Map and Soil Aerial Photo.

North Fort Hood Ground-Water Study, U.S. Army Corps of Engineers, Fort Worth District, April 1983.

2. Overburden

Overburden at the site consists of a thin mantle of residual soil developed on primary material. Material within this soil mantle is a dark brown, stiff, high plasticity clay with large amounts of limestone gravel interspersed throughout. Overburden does not totally mantle bedrock at the site revealing outcrops of primary material along the steeper margins of the site. Laboratory test data classify the material as a clayey gravel or gravelly clay. Average thickness of this stratum is 1.7-feet.

3. Primary

Primary material at the site includes in descending order: Walnut, Paluxy, and Glen Rose Formations.

Aerially, the majority of the site is supported by the Walnut Formation (see Geologic Map, Part 3). For purposes of correlation at the site, the Walnut has been divided into two units based upon predominant lithology. The upper unit of the Walnut, occurring at the higher elevations, consists mainly of clay shales that have been highly weathered to the consistency of silty, low plasticity clays. These clays are calcareous, fossiliferous, and contain thin beds of a moderately hard to hard, well-cemented, fossiliferous tan limestone. The unit reaches a maximum thickness of 34-feet in the southern portion of the site and has been completely removed by erosion to the north.

The lower unit of the Walnut is predominantly limestone with interbedded thin seams of clay shale. The limestone is hard, moderately weathered to unweathered, fossiliferous, argillaceous to sandy in zones, and light-brown to gray in color. This unit averages 23-feet in thickness, but has been completely eroded out in the northeast portion of the site.

The Paluxy Formation at the site is comprised of predominantly dark gray, soft clay shale, interbedded with seams and laminations of fine-grained, cross-bedded

sand and weakly cemented sandstones. Frequently, the clay shales, sands, and sandstones are carbonaceous. Infrequently, the Paluxy is comprised of predominantly fine-grained sand and weakly cemented sandstone interbedded with clay shale seams. The lithology of the Formation varies laterally, typical of fluctuating near shore depositional environment. The average thickness across the proposed site is 7-feet.

The deepest lithologic unit sampled by core borings is the Glen Rose Formation. The Glen Rose is a moderately hard to hard, argillaceous, fossiliferous, limestone. It is poorly bedded, with some thin clay shale seams and stringers. The limestone is unweathered, non-jointed and ranges in color from greenish-gray to gray. The Formation was not fully penetrated by exploratory borings.

4. Weathering

Primary materials are weathered to an average depth between 20 to 25-feet. The upper unit of the Walnut exhibits weathering throughout. The clay shales of this unit have been reduced to a silty, low plasticity clay. It is generally yellow-brown in color, containing some thin beds of light brown, moderately-jointed limestone. This unit is easily excavated with standard equipment.

The lower unit of the Walnut is weathered to a lesser degree. Physical weathering is predominant in this unit and occurs in the form of iron oxide stained joints. The matrix of the altered rock has been stained to a yellow-brown or reddish-brown. This material is excavated with difficulty. Below the weathered interval, the limestone is gray, non-jointed, hard, and contains stringers of black clay shale. The practical depth of excavation by standard methods is determined by the depth of weathering, as is evidenced by previous excavation operations at the southern end of the site.

5. Ground-Water

a. General

Ground-water data have been obtained from temporarily cased exploratory borings serving as observation wells. Each boring was bailed dry of all drilling fluids, cased with 2-inch slotted PVC pipe and sealed at the surface with a bentonite plug to prevent entry of surface water into the boring. Table 3 is a history of water level readings at the subject site.

The proposed sanitary landfill is situated upon materials which are capable of various types and rates of ground-water movement. Weathered clay shales allow some movement along cracks and fractures, as well as along the margins of interbedded limestone seams. The loss of structure which occurs as the shale is reduced to a clay consistency and may restrict ground-water flow and velocity. Ground-water movement in the limestones is restricted, dependent primarily upon secondary permeability features such as joints, fractures, and occasional vugs. Sand units, through interstices between individual grains, tend to be better conductors of ground-water. Restrictions to this movement develop through cementation. Due to different modes of ground-water movement in different materials types, in situ permeability is addressed below with respect to each material type.

b. In Situ Permeability

Thirty-two field permeability tests were conducted at various depths utilizing twelve cluster piezometers. Each cluster piezometer consists of three piezometer installed in the same boring at various depths and hydraulically isolated from each other. The tests were conducted in accordance with procedures outlined in Appendix IV. The intervals hydraulically isolated correspond to the lithologic units described above. Results of the field permeability tests are summarized as follows:

Lithologic Unit	Median Coefficient of Permeability
Upper Walnut Shale	1.4×10^{-5}
Lower Walnut Limestone	4.0×10^{-5}
Paluxy Formation	7.5×10^{-5}
Glen Rose Formation	3.0×10^{-5}

c. Hydraulic Gradient

Because water in the saturated zone is contained under water table conditions, the potentiometric surface conforms somewhat to local relief. The highest potentiometric levels are found along the topographically high drainage divide bisecting the proposed site and oriented along a north-south axis. Flow lines constructed perpendicular to the potentiometric lines describe the path at different points, followed by water moving through the saturated section. The direction of ground-water flow is laterally away from the central localized drainage divide. To the west of the divide, the flow direction is northwest towards the drainage path of House Creek. To the east, the flow direction is northeast towards the drainage path of Clear Creek. The average hydraulic gradient has been calculated to be 320-feet per mile, although it varies considerably over the site.

3.4.2 Active Geological Faults

Major structural features in the vicinity of the project area associated with faulting include the Balcones Fault Zone and the Llano Uplift. The Balcones Fault Zone is a complex system of normal faults treading northeast-southwest through central Texas. The fault zone occurs approximately 25 miles east of the site where the Balcones escarpment, an abrupt topographic rise, marks the west margin of the fault zone. The fault zone is approximately 5 miles wide at this point.[8] The Llano uplift raises Precambrian and Paleozoic rocks to the surface in nine counties southwest of the project site. Generally, the central core of Precambrian rocks are surrounded by a margin of Paleozoic rocks. Faults in the Paleozoic strata are comprised of

[8] Geologic Atlas of Texas, Llano Sheet, Bureau of Economic Geology, 1981.

northeast treading block faulting, which occurred during Middle Pennsylvanian time.[9] The outer margin of the faulting occurs approximately 33 miles southwest of the site at its nearest point.[10] Faulting associated with both structures is considered inactive and no faults closer to the site have been mapped. See Tectonic Map of Texas.

[9] The Ouachita System, Flawn, P.T., Goldstein, A., King, P.B., and Weaver, C.E., 1961.

[10] Bureau of Economic Geology, loc. cit.

3.5 GROUNDWATER SAMPLING AND ANALYSIS PLAN - §330.63(F)

3.6 LANDFILL GAS MANAGEMENT PLAN - §330.63(G)

The site conditions and operation of the landfill should not create problems regarding methane generation and migration. It is anticipated that the methane generated at the site from the waste will flow vertically through the methane recovery and removal system and disperse into the atmosphere. Methane generated below the liner by natural means, may collect under the dome like structure of the liner. Operational procedures for the control of methane are expected to be required during the post-closure period. A methane gas recovery and venting system has been designed to remove gases from below the FML cap after final closure. A contingency methane venting system is included in Part 3, if methane becomes a problem.

3.6.1 Methane Gas Monitoring Plan

The entire landfill shall be subject to air-monitoring requirements. The U.S. Army, Fort Hood, included this comprehensive air-monitoring plan designed to limit methane gas to less than the lower-explosive limits at the landfill boundary, and to 25 percent of the lower-explosive limits in the control building.

A. The type and frequency of monitoring proposed was based on the following factors:

   1. soil conditions - clay with low permeability;

   2. hydrogeologic conditions surrounding the facility - low water table with slow movement of water between sections;

   3. hydraulic conditions surrounding the facility - sheet flow from units into drainage ditches which empty into natural drainage systems; and

   4. the location of facility structures and property boundaries with accountability for prevailing winds - one small portable control building at the entrance to landfill and one portable building at the south fence line on Turkey Run Road, and a Maintenance building on the east border with surrounding range land owned by the U.S. Government. The nearest

housing area is 2,400-feet southeast of the landfill. The prevailing wind is from the south (26.6%) and south-southeast (12.1%).[11]

B. Initial air monitoring of the landfill was done April 1, 1994. Four methane probe wells were drilled to a depth of 7-feet at the locations given in Part 3 and shown on the drawings. Installed in each well was a 1/2-inch PVC screen pipe to total depth with a screw cap on bottom and top, with 1/4-inch hose barb protruding from top cap for sampling purposes. Each well was gravel packed from bottom of hole to 3.5-feet to bring gravel just above perforated screen height. Then 3-inches of native soil was placed in hole for an isolation layer between gravel and bentonite. Finally a 9-inch bentonite isolation layer was installed and hydrated. Native soil was placed to surface level and a protection box was placed around the top of the 1/2-inch sampler.

C. After the installation of the wells, each probe was tested for methane gas. The methane gas content was found to be zero (0) in each probe with a barometric pressure of 30.01.

D. Subsequent methane gas monitoring wells shall be drilled to the closest permanent low seasonal water table, or the depth of refuse within 1,000-feet of the probe. Upon completion of the wells, Fort Hood shall supply the TCEQ with the survey of the wells locations; natural ground elevations and top of riser at each well; depth of each well with screen length; and boring logs and well reports.

E. Air monitoring will consist of taking readings every quarter from a hand-held instrument at the existing probe locations around the perimeter of the landfill and in the existing buildings. In addition, all buildings within 1,000-feet perimeter of the facility shall be equipped with permanent, continuous monitors. Fort Hood

[11] Gray Army Airfield

shall contract the operation of the air monitoring of the facility including the requirements for data collection. The air-monitoring instrument shall be calibrated according to the directions accompanying the instrument. Testing of the instrument with a sample that contains a known organic vapor compound, will be performed prior to any sampling to ensure it is operating properly. Parameters to be analyzed for are methane, oxygen, and carbon dioxide. Readings will initially be taken from locations upwind to obtain a baseline of background air quality. Operators shall then proceed to obtain readings from the downwind side of the landfill. Comparisons of upwind readings with downwind readings shall be done to determine any differences and if there is a potentially harmful or hazardous condition existing. The spacing of the readings shall be every 150-feet, unless specified otherwise by the Executive Director. The operator shall record name, date, time, and weather conditions obtained from Fort Hood's Gray Army Airfield (wind direction, wind velocity, temperature, sunny/cloudy/partly cloudy, and barometric pressure) as a heading for tabulating the readings. This table shall be established to record the monitoring locations and accompanying instrument readings. A Methane Gas Monitoring Well Sampling Form will also be used to perform the gas monitoring (See Part 3). If needed, to verify problem areas, each location shall then be spotted on a map with the instrument readings positioned next to locations. A migration pattern may be obtained and drawn on the map with concentrations decreasing away from the source. More readings may be necessary to determine lateral extent of readings. Other information will be supplied as requested by the Executive Director.

F. After final closure of Area 1, methane gas production and settlement within the unit is expected to begin. As part of the routine maintenance and inspection schedule, Area 1, and subsequently Area 2 through 6 shall be monitored monthly for any cracks or cavities that would allow gases to escape. The area(s) shall be monitored before a spark-producing device or machine enters the unit for purposes of performing a task involving the use of these spark-producing devices

or machines. A permit procedure shall be administered to prevent inadvertent entry and activity, and/or operation of these spark producing devices or machines into those areas of passive gas venting. A list of illegal practices and ignition sources shall be developed that will include, as a minimum, the following: flares; smoking or flames; firearms; heliarc welding; or torch cutting equipment. This list will be posted on a sign at the entrance, along with the requirements for permits in passive gas venting areas, and amended as needed to inform all personnel entering the landfill.

G. If methane gas levels exceeding the limits specified in this section are detected, Fort Hood shall:

1. immediately take all necessary steps to ensure protection of human health and notify the Executive Director;

2. within seven days of detection, submit a report to the Executive Director that provides the methane gas levels detected and a description of the steps taken to protect human health and the environment; and

3. within 30 days of detection, submit a remediation plan for the methane gas releases to the Executive Director. The plan shall describe the nature and extent of the problems and the proposed remedy and shall include an implementation schedule. The plan shall be implemented within 60 days of detection.

The U.S. Army shall notify the Executive Director when strong odors occur at facility boundaries. Records of inspections and surveys shall be maintained at the facility. Odors shall be controlled by the best means practicable.

3.7 CLOSURE PLAN - §330.63(H)

A. The landfill site is separated into three phrases.

B. Based on anticipated solid waste generation rates for Fort Hood, this landfill will be closed in 2011.

C. Landfill areas will be filled vertically up to 3 to 4-feet below the finished contours shown on Permit Modification Design Drawings, Part 3. Eighteen inches of intermediate final cover will be placed over the final lift of solid waste and daily cover material at the end of each day, so that these elevations are reached. All areas that have received waste but will be inactive for longer than 180 days shall provide intermediate cover. This operation will continue laterally in each expansion of the Area until the topographically high elevation on the line has been reached, then the operation will proceed to the next successive topographically low elevation in that Area, to begin operations and deposit waste until the high point is reached again. Final cover will then be applied to the entire Area.

1. Final Cover of the entire area will be applied no later than 30 days after final grades are reached in each area of the landfill, and no later than 30 days after the final date of known receipt of solid waste in the area. This deadline may be extended by the Executive Director to a maximum of 60 days.

2. Standing water will be removed.

3. The runoff diversion system will be maintained until final cover is installed, and will be modified to prevent overflow of the landfill to adjoining areas.

4. Insect and rodent inspection will be documented before installation of final cover, and extermination measures used, if required, as a result of inspection.

5. A gas collection and venting system will be installed in each Area between the waste with intermediate final cover and the final cover.

    a. The gas collection and venting system will consist of perforated high-density polyethylene pipe in a 1-foot square trench surrounded by graded gravel. The gravel shall be sized to ensure it is larger than the one-half inch (1/2") perforations in the collection pipe.

    b. The perforated pipe will be connected to a solid, rise pipe and gas vent to complete a passive collection and removal system. Whatever synthetic membrane is used for the liner and cap system, the same type of material or comparable material should be used in the piping systems throughout the landfill (i.e., polyethylene pipe with polyethylene FML and polyethylene FML Cap).

    c. A geotextile or graded soil filter will surround the graded gravel.

6. A final cover will be placed on top of the intermediate final cover which consists of 18 inches of compacted clay with a permeability of less than 1×10^{-5} cm/sec or be at least as impermeable as the intermediate final cover.

7. A very low-density textured polyethylene, a minimum of 60-mils thickness, or comparable synthetic membrane, will be installed on top of the recompacted clay layer. The polyethylene cap layer will be entrenched with the polyethylene line and will be welded together to provide a seal between the cap and liner.

8. A minimum of 6-inches of topsoil shall be installed on top of the polyethylene. The depth of the topsoil should be increased if it is

determined that 6-inches of topsoil is not sufficient to support sufficient grassroot growth.

9. After closure inspection and approval, the U.S. Army will plant ground cover to prevent erosion and to return the landfill to a more natural appearance. Prior to the establishment of grass, an application system (i.e., a mulching) designed to control erosion and to promote soil retention and grassroot growth, may be used on the final soil layer.

10. The finished surfaces of the select fill will be maintained and inspected for vermin until turfing is accomplished. All finished surfaces of select fill, embankments, ditches, and areas disturbed by construction operations will receive turfing. Earthwork and turfing will be in accordance with the drawings in Part 3.

11. The U.S. Army will update the Coryell County mortgage and conveyance records, by entering the specific location of the landfill and specifying that the property was used for the disposal of solid waste.

3.8 POST-CLOSURE PLAN - §330.63(I)

A. After closure, a scheduled maintenance program will be established to include monthly inspections and repairs, as necessary, to maintain vigorous vegetation growth, refurbish surface soils damaged through erosion, shrinkage, subsidence, or animal burrowing, repair damaged fencing, and to upkeep monitoring wells. No development, human habitation, or recreational activities will occur on this site.

B. To assure public safety, the integrity of boundary fencing and access points will be maintained. Security forces and maintenance crews will monitor the site monthly. The Directorate of Public Works shall be responsible for overseeing the Post-Closure Care Maintenance. The address is U.S. Army, Headquarters III Corps and Fort Hood, Fort Hood, Texas 76544. The telephone number is (254) 287-5500/5707. No habitable structures or public use areas (with the exception of roadways) will be constructed within 2,000-feet of the landfill. There is no plans in place to use the closed areas of the landfill.

C. Areas will remain in post-closure care for 30 years after closure of the landfill, unless it can be shown that the landfill is no longer a threat to human health and the environment, and approved by the Executive Director for a shorter length of time.

1. Leachate collection and removal will continue until leachate is no longer generated or until the U.S. Army can demonstrate that the leachate no longer poses a threat to human health or the environment.

2. Gas collection and removal will continue after closure.

3. Air monitoring will continue until the U.S. Army can demonstrate that the gas no longer poses a threat to human health or the environment and is approved by the Executive Director.

4. According to the Ground-Water Monitoring Plan, ground-water monitoring will continue after closure.

D. Ownership of the site will remain with the U.S. Government after closure.

E. Prior to abandonment of any monitoring well, the applicant will notify the Executive Director in writing of his intent. No well shall be abandoned until approval is obtained.

3.9 COST ESTIMATE FOR CLOSURE AND POST-CLOSURE CARE - §330.63(J)