Lewis County
Department of Public Works
Engineering Division

CONTRACT PROVISIONS AND PLANS
FOR CONSTRUCTION OF:

SOUTH LEWIS COUNTY AIRPORT (TDO)
Improvements Project

A.I.P. No. 3-53-0078-009-2017

February, 2020

BOOK 3 OF 3

LEWIS COUNTY
DEPARTMENT OF PUBLIC WORKS
APPROVED AS TO FORM:

LEWIS COUNTY DIRECTOR, P.E. — Date 1/28/2020

BOARD OF COUNTY COMMISSIONERS

Edna J. Fund, District No. 1
Robert C. Jackson, District No. 2
Gary Stamper, District No. 3

SECTION IV

FEDERAL WAGE RATES

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These Federal Wages have been removed and are replaced with the wage rates listed in the New Section 2

SECTION V

GEOTECHNICAL INFORMATION

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GEOTECHNICAL & PAVEMENT ENGINEERING REPORT
SOUTH LEWIS COUNTY AIRPORT TAXIWAY RECONSTRUCTION
LEWIS COUNTY, WASHINGTON

HWA Project No. 2015-094-21

February 26, 2016

Prepared for:

WHPacific, Inc.

HWA GeoSciences Inc.

CORE-9 CORE DESIGNATION AND APPROXIMATE LOCATION

TP-14 TEST PIT DESIGNATION AND APPROXIMATE LOCATION

CBR ▪ LOCATION OF TEST PIT WHERE CBR TEST WAS PERFORMED ON SAMPLE

0 100 200 300 400 500 600

N

HWA GEOSCIENCES INC.

GEOTECHNICAL & PAVEMENT ENGINEERING REPORT
SOUTH LEWIS COUNTY AIRPORT
TAXIWAY RECONSTRUCTION
LEWIS COUNTY, WASHINGTON

SITE AND EXPLORATION PLAN

DRAWN BY	EFK
CHECK BY	BH/CJ
DATE:	02.12.16
FIGURE #	2
PROJECT #	2015-094-21

S:\2015 PROJECTS\2015-094 S LEWIS CO AIRPORT\CAD 2015-094\2015-094 BM.DWG <Layout1> Plotted: 2/12/2016 10:58 AM

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALUE

COHESIONLESS SOILS			COHESIVE SOILS		
Density	N (blows/ft)	Approximate Relative Density(%)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	0 - 15	Very Soft	0 to 2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	35 - 65	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	over 30	>4000

USCS SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP DESCRIPTIONS	
Coarse Grained Soils	Gravel and Gravelly Soils	Clean Gravel (little or no fines)	GW	Well-graded GRAVEL
	More than 50% of Coarse Fraction Retained on No. 4 Sieve		GP	Poorly-graded GRAVEL
		Gravel with Fines (appreciable amount of fines)	GM	Silty GRAVEL
			GC	Clayey GRAVEL
More than 50% Retained on No. 200 Sieve Size	Sand and Sandy Soils	Clean Sand (little or no fines)	SW	Well-graded SAND
	50% or More of Coarse Fraction Passing No. 4 Sieve		SP	Poorly-graded SAND
		Sand with Fines (appreciable amount of fines)	SM	Silty SAND
			SC	Clayey SAND
Fine Grained Soils	Silt and Clay	Liquid Limit Less than 50%	ML	SILT
			CL	Lean CLAY
			OL	Organic SILT/Organic CLAY
50% or More Passing No. 200 Sieve Size	Silt and Clay	Liquid Limit 50% or More	MH	Elastic SILT
			CH	Fat CLAY
			OH	Organic SILT/Organic CLAY
Highly Organic Soils			PT	PEAT

TEST SYMBOLS

%F	Percent Fines
AL	Atterberg Limits: PL = Plastic Limit, LL = Liquid Limit
CBR	California Bearing Ratio
CN	Consolidation
DD	Dry Density (pcf)
DS	Direct Shear
GS	Grain Size Distribution
K	Permeability
MD	Moisture/Density Relationship (Proctor)
MR	Resilient Modulus
PID	Photoionization Device Reading
PP	Pocket Penetrometer Approx. Compressive Strength (tsf)
SG	Specific Gravity
TC	Triaxial Compression
TV	Torvane Approx. Shear Strength (tsf)
UC	Unconfined Compression

SAMPLE TYPE SYMBOLS

- 2.0" OD Split Spoon (SPT) (140 lb. hammer with 30 in. drop)
- Shelby Tube
- 3-1/4" OD Split Spoon with Brass Rings
- Small Bag Sample
- Large Bag (Bulk) Sample
- Core Run
- Non-standard Penetration Test (3.0" OD split spoon)

GROUNDWATER SYMBOLS

- Groundwater Level (measured at time of drilling)
- Groundwater Level (measured in well or open hole after water level stabilized)

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5 mm) to No. 200 (0.074 mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

COMPONENT PROPORTIONS

PROPORTION RANGE	DESCRIPTIVE TERMS
< 5%	Clean
5 - 12%	Slightly (Clayey, Silty, Sandy)
12 - 30%	Clayey, Silty, Sandy, Gravelly
30 - 50%	Very (Clayey, Silty, Sandy, Gravelly)
Components are arranged in order of increasing quantities.	

NOTES: Soil classifications presented on exploration logs are based on visual and laboratory observation.
Soil descriptions are presented in the following general order:

Density/consistency, color, modifier (if any) GROUP NAME, additions to group name (if any), moisture content. Proportion, gradation, and angularity of constituents, additional comments. (GEOLOGIC INTERPRETATION)

Please refer to the discussion in the report text as well as the exploration logs for a more complete description of subsurface conditions.

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
MOIST	Damp but no visible water.
WET	Visible free water, usually soil is below water table.

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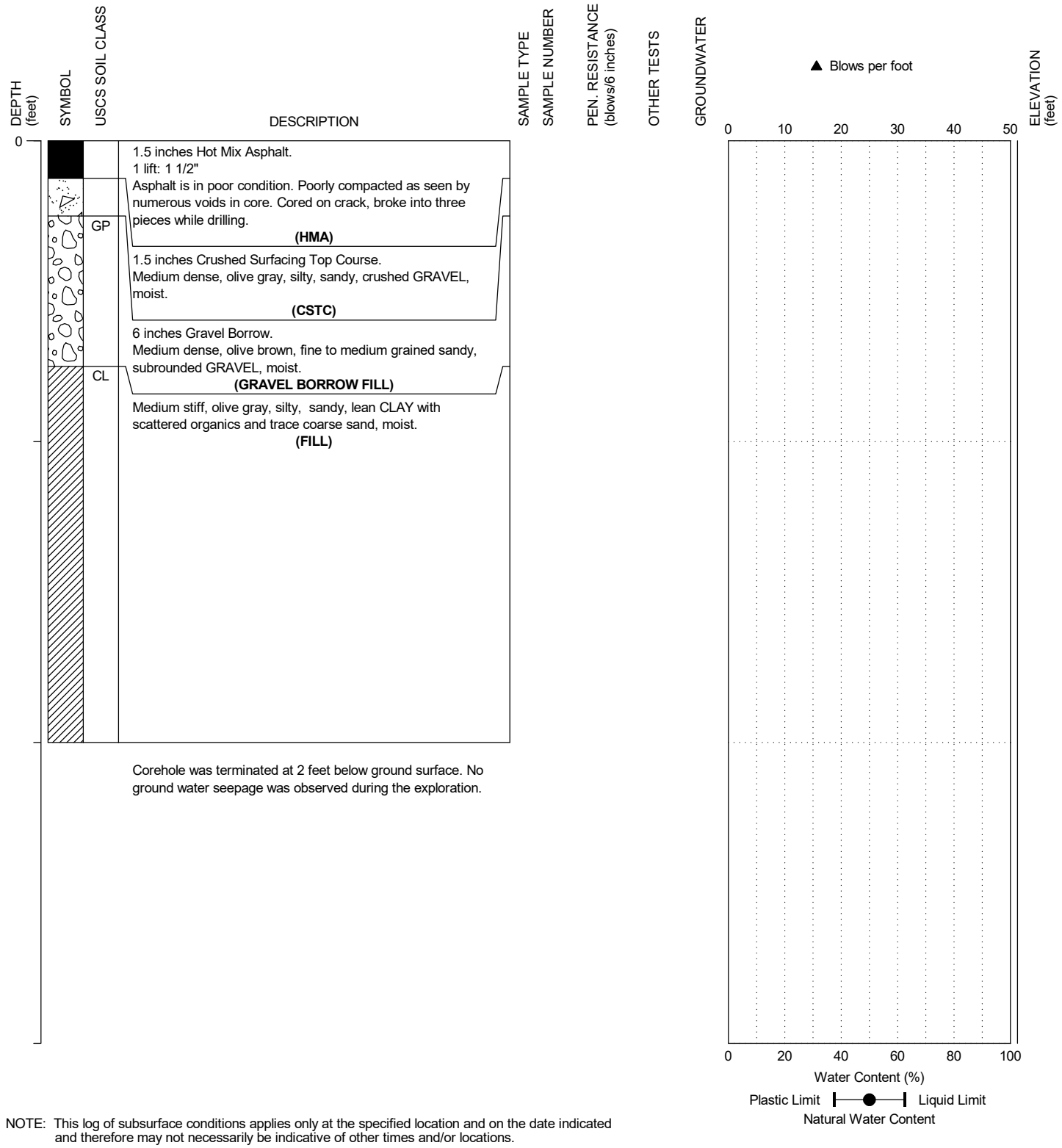
South Lewis County Airport
2016/2017 Airport Improvements Project

LEGEND OF TERMS AND SYMBOLS USED ON EXPLORATION LOGS

PROJECT NO.: 2015-094-21 FIGURE: A-1

DRILLING COMPANY: HWA GeoSciences Inc.
DRILLING METHOD: Core Drill and Hand Bucket Auger
SAMPLING METHOD: Grab
LOCATION: See Figure 2

DATE STARTED: 12/17/2015
DATE COMPLETED: 12/17/2015
LOGGED BY: S. Pemble



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

South Lewis County Airport
2016/2017 Airport Improvements Project

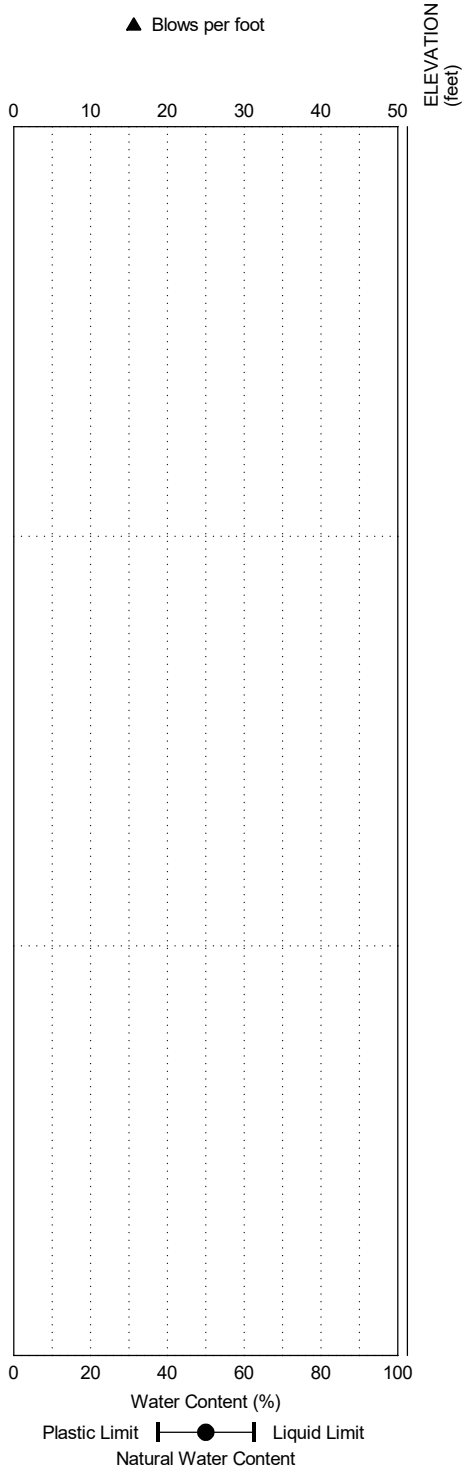
Pavement Core
Core-1

PROJECT NO.: 2015-094-21 FIGURE: A-2

DRILLING COMPANY: HWA GeoSciences Inc.
DRILLING METHOD: Core Drill and Hand Bucket Auger
SAMPLING METHOD: Grab
LOCATION: See Figure 2

DATE STARTED: 12/17/2015
DATE COMPLETED: 12/17/2015
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0			1.25 inches Hot Mix Asphalt. 1 lift: 1 1/4" Asphalt is in fair condition. No crack at core location. Poorly bonded, broke into three pieces upon removal from hole. **(HMA)**					
		GP	8.75 inches Gravel Borrow Medium dense, olive brown, fine to medium grained sandy, subrounded GRAVEL, moist. **(GRAVEL BORROW FILL)**					
		CL	Medium stiff, gray, silty, sandy, lean CLAY with decomposing grass, moist. **(FILL)**					
			Corehole was terminated at 2 feet below ground surface. No ground water seepage was observed during the exploration.					



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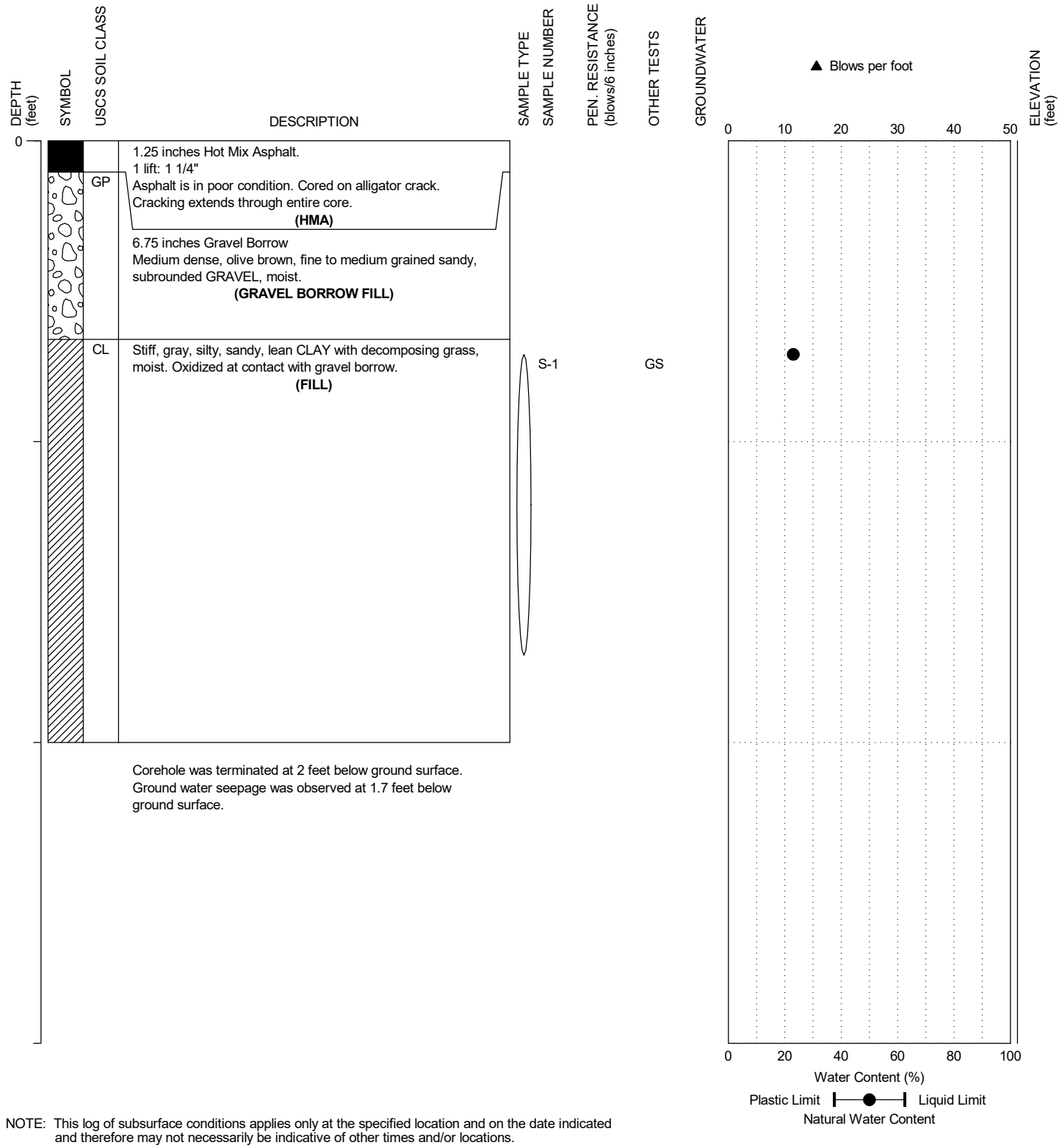
2016/2017 Airport Improvements Project

Pavement Core
Core-2

PROJECT NO.: 2015-094-21 FIGURE: A-3

DRILLING COMPANY: HWA GeoSciences Inc.
DRILLING METHOD: Core Drill and Hand Bucket Auger
SAMPLING METHOD: Grab
LOCATION: See Figure 2

DATE STARTED: 12/17/2015
DATE COMPLETED: 12/17/2015
LOGGED BY: S. Pemble



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South Lewis County Airport
2016/2017 Airport Improvements Project

Pavement Core
Core-3

PROJECT NO.: 2015-094-21 FIGURE: A-4

DRILLING COMPANY: HWA GeoSciences Inc.
DRILLING METHOD: Core Drill and Hand Bucket Auger
SAMPLING METHOD: Grab
LOCATION: See Figure 2

DATE STARTED: 12/17/2015
DATE COMPLETED: 12/17/2015
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION
0			1.25 inches Hot Mix Asphalt. 1 lift: 1 1/4" Asphalt is in poor condition. Local severe transverse and longitudinal cracking. No crack at core location. Core broke into three pieces upon retrieval from core hole. **(HMA)**
		GP	7.25 inches Gravel Borrow Dense, olive brown, slightly silty, fine to coarse grained sandy, subrounded GRAVEL, moist. **(GRAVEL BORROW FILL)**
		CL	Stiff, gray, silty, sandy, lean CLAY with decomposing grass, moist. Oxidized at contact with gravel borrow. **(FILL)**
			Corehole was terminated at 2 feet below ground surface. No ground water seepage was observed during the exploration.

SAMPLE TYPE
SAMPLE NUMBER
PEN. RESISTANCE (blows/6 inches)
OTHER TESTS
GROUNDWATER

▲ Blows per foot

0 10 20 30 40 50

ELEVATION (feet)

0 20 40 60 80 100

Water Content (%)

Plastic Limit — Liquid Limit

Natural Water Content

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

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South Lewis County Airport
2016/2017 Airport Improvements Project

Pavement Core
Core-4

PROJECT NO.: 2015-094-21 FIGURE: A-5

DRILLING COMPANY: HWA GeoSciences Inc.
DRILLING METHOD: Core Drill and Hand Bucket Auger
SAMPLING METHOD: Grab
LOCATION: See Figure 2

DATE STARTED: 12/17/2015
DATE COMPLETED: 12/17/2015
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION
0			1.0 inches Hot Mix Asphalt. 1 lift: 1" Asphalt is in poor condition. Local moderate severity alligator cracking. Not cored on crack. Core broke into six pieces while coring. **(HMA)**
		GP	6.5 inches Gravel Borrow Medium dense, olive brown, slightly silty, fine to medium grained sandy, subrounded GRAVEL, moist. **(GRAVEL BORROW FILL)**
		CL	Stiff, gray, silty, sandy, lean CLAY with decomposing grass, moist. Oxidized at contact with gravel borrow. **(FILL)**

Corehole was terminated at 2 feet below ground surface. No ground water seepage was observed during the exploration.

SAMPLE TYPE
SAMPLE NUMBER
PEN. RESISTANCE (blows/6 inches)
OTHER TESTS
GROUNDWATER

▲ Blows per foot

0 10 20 30 40 50

ELEVATION (feet)

0 20 40 60 80 100

Water Content (%)

Plastic Limit — Liquid Limit

Natural Water Content

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

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South Lewis County Airport
2016/2017 Airport Improvements Project

Pavement Core
Core-5

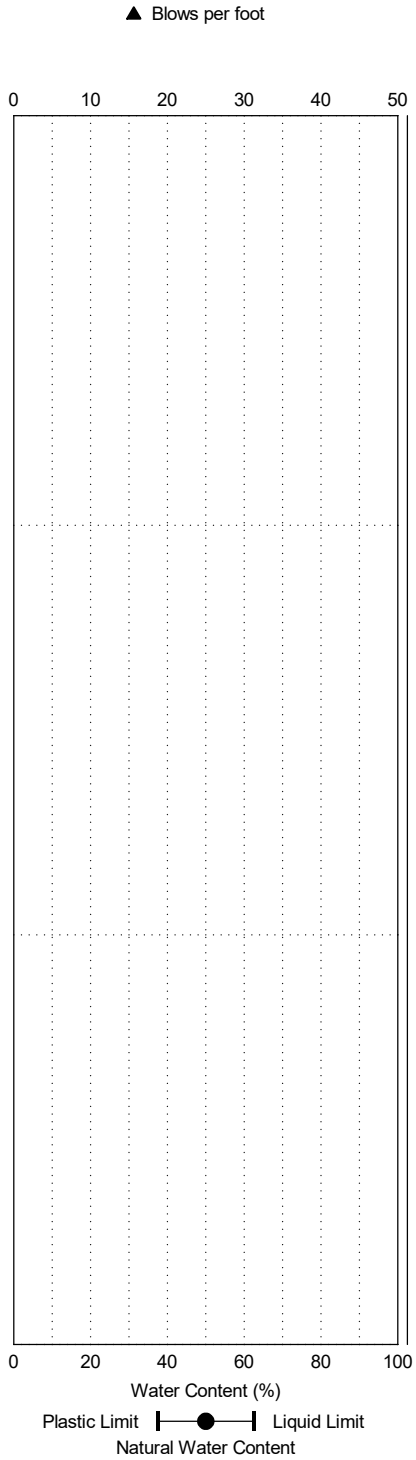
PROJECT NO.: 2015-094-21 FIGURE: A-6

DRILLING COMPANY: HWA GeoSciences Inc.
DRILLING METHOD: Core Drill and Hand Bucket Auger
SAMPLING METHOD: Grab
LOCATION: See Figure 2

DATE STARTED: 12/17/2015
DATE COMPLETED: 12/17/2015
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER	ELEVATION (feet)
0			1.25 inches Hot Mix Asphalt. 1 lift: 1 1/4"						
		GP	Asphalt is in fair condition. Local severe tranverse cracking with low severity longitudinal and alligator cracking. Not cored on crack. **(HMA)**						
			7.75 inches Gravel Borrow. Medium dense, olive brown, fine to medium grained sandy, subrounded GRAVEL, moist. **(GRAVEL BORROW FILL)**						
		CL	Medium stiff, yellow brown, silty, lean CLAY with trace decomposing grass, moist. **(FILL)**						
		CL	Stiff, gray, silty, lean CLAY, moist. **(FILL)**						

Corehole was terminated at 2 feet below ground surface. No ground water seepage was observed during the exploration.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

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South Lewis County Airport
2016/2017 Airport Improvements Project

Pavement Core
Core-6

PROJECT NO.: 2015-094-21 FIGURE: A-7

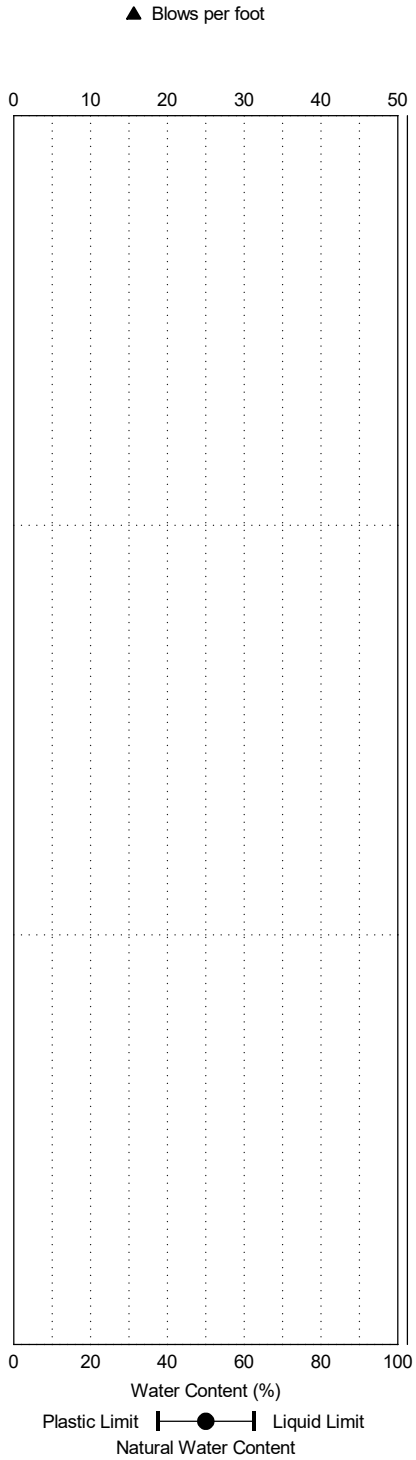
DRILLING COMPANY: HWA GeoSciences Inc.
DRILLING METHOD: Core Drill and Hand Bucket Auger
SAMPLING METHOD: Grab
LOCATION: See Figure 2

DATE STARTED: 12/17/2015
DATE COMPLETED: 12/17/2015
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION
0			3.0 inches Hot Mix Asphalt. 1 lift: 3" Asphalt is in fair condition. Minor transverse cracking near core location. Not cored on crack. **(HMA)**
		GP	1.0 inch Crushed Surfacing Base Course. Medium dense, olive brown, sandy, medium subrounded and crushed GRAVEL, moist. **(CSBC)**
			5 inches Gravel Borrow. Dense, olive brown, fine to medium grained sandy, subrounded and crushed, fine to medium GRAVEL, moist. **(GRAVEL BORROW FILL)**
			5 inches Crushed Surfacing Base Course. Dense, olive brown, sandy, medium to coarse, crushed GRAVEL, moist. **(CSBC)**
		CL	Stiff, yellow brown with mottled gray, silty, lean CLAY, moist. <<(FILL)

Corehole was terminated at 2 feet below ground surface. No ground water seepage was observed during the exploration.

SAMPLE TYPE / SAMPLE NUMBER / PEN. RESISTANCE (blows/6 inches) / OTHER TESTS / GROUNDWATER



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HWA GEOSCIENCES INC.

South Lewis County Airport
2016/2017 Airport Improvements Project

Pavement Core
Core-7

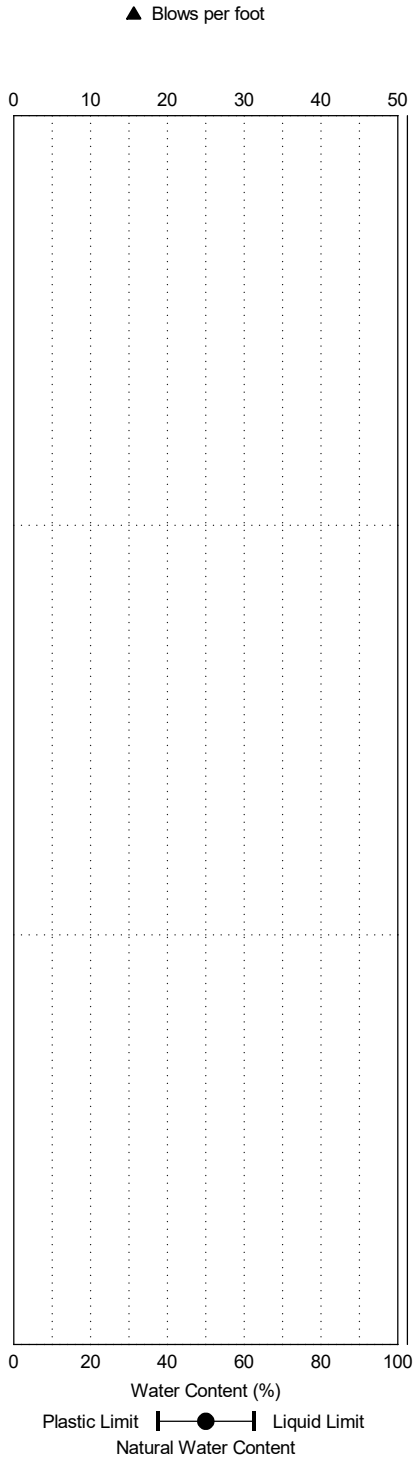
PROJECT NO.: 2015-094-21 FIGURE: A-8

DRILLING COMPANY: HWA GeoSciences Inc.
DRILLING METHOD: Core Drill and Hand Bucket Auger
SAMPLING METHOD: Grab
LOCATION: See Figure 2

DATE STARTED: 12/17/2015
DATE COMPLETED: 12/17/2015
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION
0			2.5 inches Hot Mix Asphalt. 1 lift: 2 1/2" Asphalt is in poor condition. Cored on longitudinal crack. Local moderate severity longitudinal and transverse cracking. **(HMA)**
		GP	8.5 inches Gravel Borrow. Medium dense, olive brown, slightly silty, fine to medium grained sandy, subrounded GRAVEL, moist. **(GRAVEL BORROW FILL)**
		CL	Stiff, gray, silty, lean CLAY, moist. **(FILL)**
			Corehole was terminated at 2 feet below ground surface. No ground water seepage was observed during the exploration.

SAMPLE TYPE | SAMPLE NUMBER | PEN. RESISTANCE (blows/6 inches) | OTHER TESTS | GROUNDWATER



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

South Lewis County Airport
2016/2017 Airport Improvements Project

Pavement Core
Core-8

PROJECT NO.: 2015-094-21 FIGURE: A-9

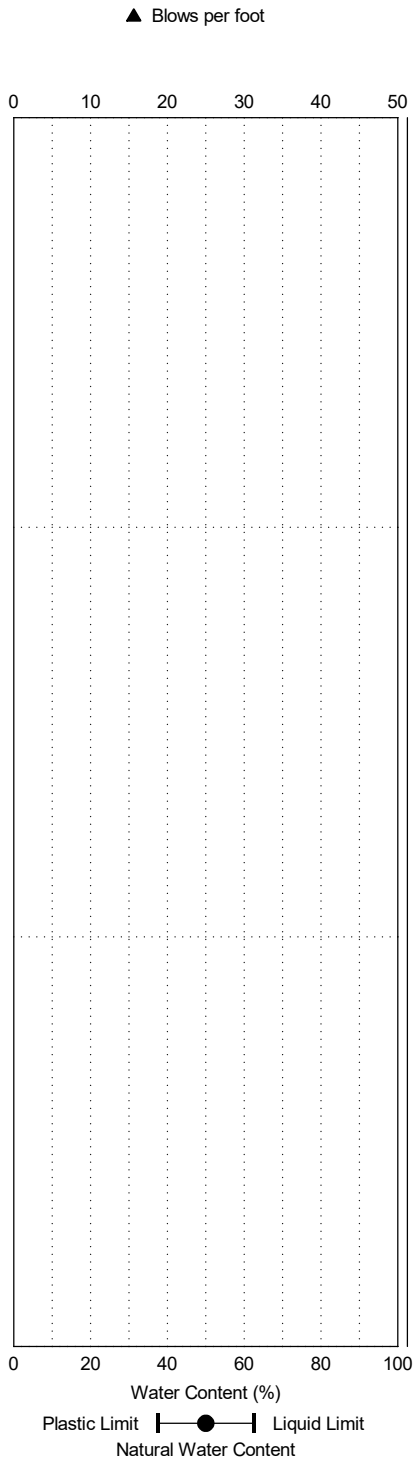
DRILLING COMPANY: HWA GeoSciences Inc.
DRILLING METHOD: Core Drill and Hand Bucket Auger
SAMPLING METHOD: Grab
LOCATION: See Figure 2

DATE STARTED: 12/17/2015
DATE COMPLETED: 12/17/2015
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION
0			2.5 inches Hot Mix Asphalt. 1 lift: 2 1/2" Asphalt is in poor condition. Cored on low severity alligator cracking. Core broke into two pieces while drilling. **(HMA)**
		GP	12.0 inches Gravel Borrow Medium dense, olive brown, slightly silty, fine to medium grained sandy, subrounded GRAVEL, moist. **(GRAVEL BORROW FILL)**
		CL	Stiff, yellow brown, silty, lean CLAY, moist. **(FILL)**

Corehole was terminated at 2 feet below ground surface. No ground water seepage was observed during the exploration.

SAMPLE TYPE
SAMPLE NUMBER
PEN. RESISTANCE (blows/6 inches)
OTHER TESTS
GROUNDWATER



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HWA GEOSCIENCES INC.

South Lewis County Airport
2016/2017 Airport Improvements Project

Pavement Core
Core-9

PROJECT NO.: 2015-094-21 FIGURE: A-10

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/15/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	OTHER TESTS
0		CH	Soft, dark brown, fat CLAY with rootlets and decomposed organics, moist. **(TOPSOIL)**		S-1		GS
2		CH	Soft to medium stiff, olive brown, plastic, fat CLAY with trace organics, moist to wet. **(ALLUVIUM)**		S-2	▽	GS
		CH	Stiff to very stiff, light brown with yellow brown mottling, plastic, gravelly fat CLAY with highly weathered porphyritic andesite and dacite gravel and cobbles, moist. Trace volcanic ejecta. Gravel and cobbles have 0.25 to 0.5 inch oxidized and clay altered weathering rinds. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**		S-3		GS
8		GC	Very stiff to hard, light brown with yellow brown mottling, GRAVEL with plastic clayey silt matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**				
10			Test pit was terminated at 10 feet below ground surface. Ground water seepage was observed at 2.6 feet below ground surface. Gravelly clay layer creates a restrictive layer to water infiltration.				
12							
14							

▲ Approximate N-value

0 10 20 30 40 50

0 25 50 75 100

Water Content (%)

Plastic Limit — Liquid Limit

Natural Water Content

PHOTO OF WEST SIDE OF PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT
TP-01

PROJECT NO.: 2015-094-21 FIGURE: A-11

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/15/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	OTHER TESTS
0		ML	Soft, dark brown, SILT with rootlets and decomposed organics, moist. **(TOPSOIL)**		S-1		GS
2		CH	Soft to medium stiff, yellow brown, plastic, fat CLAY with trace fine sand and organics, moist to wet. **(ALLUVIUM)**		S-2	▽	GS
		CH	Stiff to very stiff, light brown with dark yellow brown mottling, plastic, gravelly fat CLAY with highly weathered porphyritic andesite and dacite gravel and scattered cobbles, moist. Trace volcanic ejecta. Gravel and cobbles have 0.25 to 0.5 inch oxidized and clay altered weathering rinds. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**		S-3		
8		GC	Very stiff to hard, light yellow brown, GRAVEL with plastic fine sandy clay matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**				
10			Test pit was terminated at 10 feet below ground surface. Ground water seepage was observed at 2.7 feet below ground surface. Gravelly clay layer creates a restrictive layer to water infiltration.				
12							
14							

▲ Approximate N-value

0 10 20 30 40 50

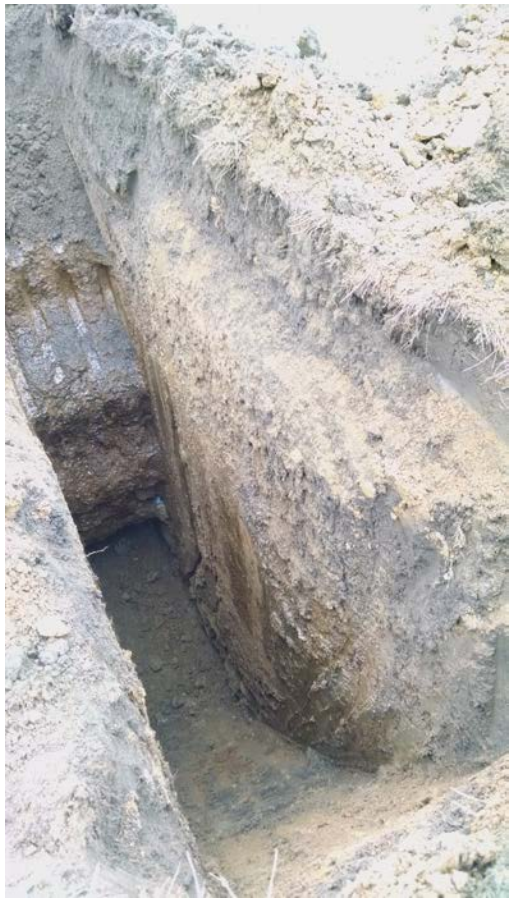
0 25 50 75 100

Water Content (%)

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

PHOTO OF WEST SIDE OF PIT



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HWA GEOSCIENCES INC.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT
TP-02

PROJECT NO.: 2015-094-21 FIGURE: A-12

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/15/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	OTHER TESTS
0 – 2		CH	Soft to medium stiff, light yellow brown, plastic, silty, fat CLAY with trace fine sand and organics, moist to wet. **(ALLUVIUM)**		S-1		GS AL
2 – 4		CH	Stiff to very stiff, yellow brown with gray mottling, plastic, gravelly fat CLAY with highly weathered porphyritic andesite and dacite gravel and scattered cobbles, moist. Trace volcanic ejecta. Gravel and cobbles have 0.25 to 0.5 inch oxidized and clay altered weathering rinds. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**		S-2	▽	GS
4 – 8		GC	Very stiff to hard, light yellow brown, GRAVEL with plastic fine sandy clay matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**				

Test pit was terminated at 9.3 feet below ground surface. Ground water seepage was observed at 2.0 feet below ground surface. Gravelly clay layer creates a restrictive layer to water infiltration.

▲ Approximate N-value

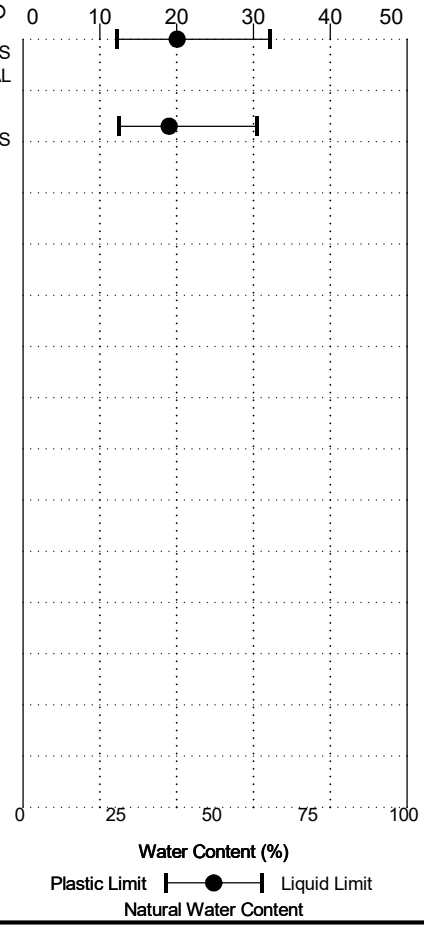


PHOTO OF WEST SIDE OF PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT
TP-03

PROJECT NO.: 2015-094-21 FIGURE: A-13

DJH TP 2015-094-21.GPJ 1/21/16

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/15/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	OTHER TESTS
0 – 4		CL	Stiff, yellow brown, plastic, gravelly lean CLAY with rootlets, highly weathered volcanoclastic gravel and scattered cobbles, moist. Gravel and cobbles have 0.25 to 0.5 inch oxidized and clay altered weathering rinds. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**		S-1	▽	GS CBR
4 – 10		GC	Very stiff to hard, light yellow brown, GRAVEL with plastic fine sandy clay matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**				

Test pit was terminated at 10 feet below ground surface. Water was pooling at the surface. An isolated lense allowing for ground water seepage was observed at 3 feet below ground surface.

▲ Approximate N-value

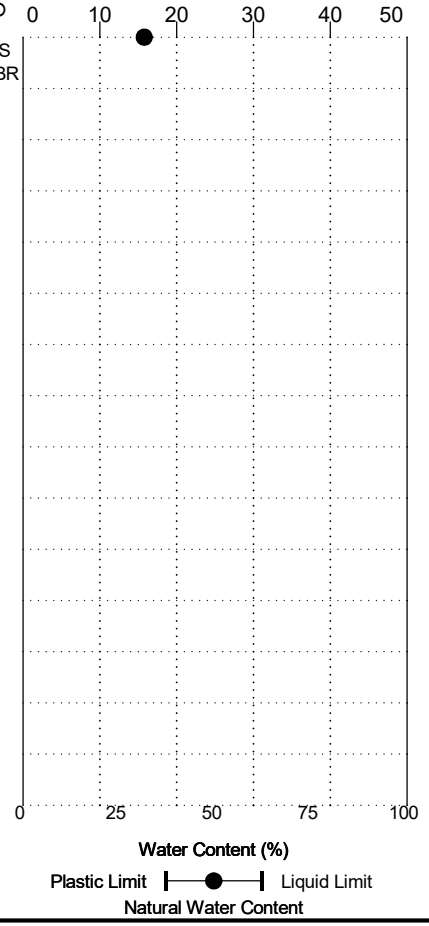


PHOTO OF WEST SIDE OF PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GeoSciences Inc.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT
TP-04

PROJECT NO.: 2015-094-21 FIGURE: A-14

DJH TP 2015-094-21.GPJ 1/21/16

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/15/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	OTHER TESTS
0		ML	Soft, dark brown, SILT with rootlets and decomposed organics, moist.		S-1		
		CH	**(TOPSOIL)**		S-2		
2			Medium stiff to stiff, olive brown, plastic, silty, fat CLAY with trace organics, moist to wet. **(ALLUVIUM)**			▽	
		CH	Stiff, yellow brown, plastic, fat CLAY with scattered subrounded volcanoclastic gravel, moist. Gravel is highly oxidized and clay altered. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**		S-3		
4		CH	Stiff to very stiff, light brown with yellow brown mottling, plastic, gravelly, fat CLAY with highly weathered volcanoclastic gravel and cobbles, moist. Gravel and cobbles have 0.25 to 0.5 inch oxidized and clay altered weathering rinds. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**				
6							
8							
10		GC	Hard, light brown with yellow brown mottling, GRAVEL with plastic clay matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**				
12							
14							

Test pit was terminated at 10 feet below ground surface. Ground water seepage was observed at 2.6 feet below ground surface. Gravelly clay layer creates a restrictive layer to water infiltration.

▲ Approximate N-value

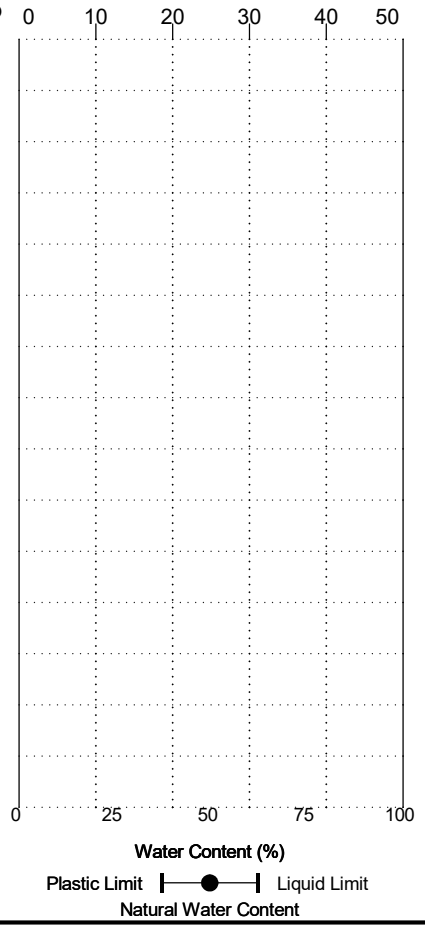


PHOTO OF EAST SIDE OF PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT
TP-05

PROJECT NO.: 2015-094-21 FIGURE: A-15

DJH TP 2015-094-21.GPJ 1/21/16

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/15/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	OTHER TESTS
0			Soft, dark brown, silty, ORGANICS, moist. **(TOPSOIL)**				
2		CH	Soft, dark brown, fat CLAY with rootlets and decomposed organics, moist. **(TOPSOIL)**		S-1		
4		CH	Stiff to very stiff, light brown with dark yellow brown mottling, plastic, gravelly CLAY with highly weathered volcanoclastic gravel and scattered cobbles, moist. Gravel and cobbles have 0.25 to 0.5 inch oxidized an clay altered weathering rinds. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**		S-2		
6		GC				▽	
8			Very stiff to hard, light yellow brown, GRAVEL with plastic fine sandy clay matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**				
10			Test pit was terminated at 8.5 feet below ground surface. Ground water seepage was observed at 6.0 feet below ground surface.				
12							
14							

▲ Approximate N-value

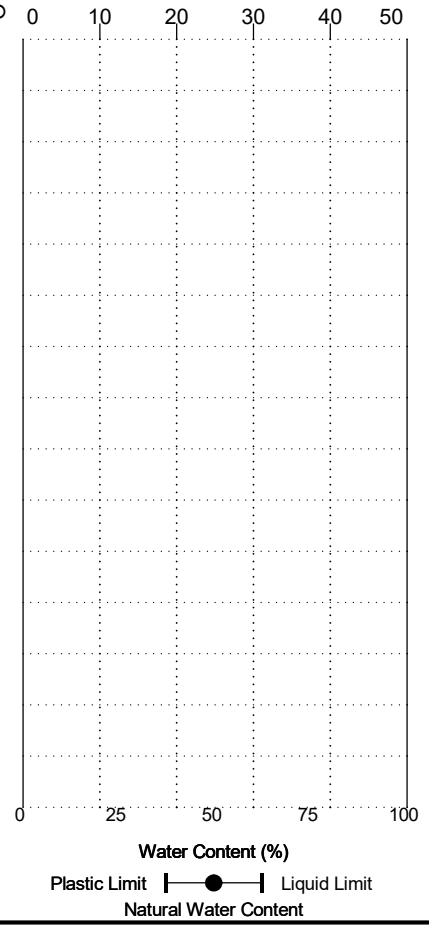


PHOTO OF WEST SIDE OF PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GeoSciences Inc.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT
TP-06

PROJECT NO.: 2015-094-21 FIGURE: A-16

DJH TP 2015-094-21.GPJ 1/21/16

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/15/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	OTHER TESTS
0		ML	Soft, dark brown, SILT with rootlets and decomposed organics, moist. **(TOPSOIL)**		S-1		
2		CH	Medium stiff, olive brown, plastic, silty, fat CLAY with trace organics, moist to wet. **(ALLUVIUM)**		S-2	GS	
4		CH	Stiff, yellow brown, plastic, fat CLAY with scattered subrounded volcanoclastic gravel, moist. Gravel is highly oxidized and clay altered. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**		S-3	▽	
8		GC	Hard, light brown with yellow brown mottling, GRAVEL with plastic clay matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**				
10			Test pit was terminated at 10 feet below ground surface. Ground water seepage was observed at 3.5 feet below ground surface. Gravelly clay layer creates a restrictive layer to water infiltration.				
12							
14							

▲ Approximate N-value

0 10 20 30 40 50

0 25 50 75 100

Water Content (%)

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

PHOTO OF WEST SIDE OF PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT
TP-07

PROJECT NO.: 2015-094-21 FIGURE: A-17

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/16/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION
0		CH	Medium stiff, olive brown, plastic, silty, fat CLAY with trace organics, moist.
		CH	**(ALLUVIUM)**
2			Stiff, yellow brown, plastic, fat CLAY with scattered subrounded volcanoclastic gravel, moist. Gravel is highly oxidized and clay altered. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**
4			Density increase to very stiff at 4 feet below ground surface.
6			
8		GC	Hard, light brown with yellow brown mottling, GRAVEL with plastic clay matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**
10			Test pit was terminated at 8 feet below ground surface. Minor ground water seepage was observed at 8 feet below ground surface. Standing water was observed at the surface of the excavation.
12			
14			

SAMPLE TYPE | SAMPLE NUMBER | GROUND WATER | OTHER TESTS

▲ Approximate N-value

0 10 20 30 40 50

0 25 50 75 100

Water Content (%)

Plastic Limit — Liquid Limit

Natural Water Content

PHOTO OF WEST SIDE OF PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GeoSciences Inc.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT
TP-08

PROJECT NO.: 2015-094-21 FIGURE: A-18

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/16/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	OTHER TESTS
0			Soft, dark brown, silty, ORGANICS, moist. **(TOPSOIL)**		S-1		GS AL
2		CH	Stiff, yellow brown, plastic, fat CLAY with scattered subrounded volcanoclastic gravel, moist. Gravel is highly oxidized and clay altered. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)** Density increase to very stiff at 3 feet below ground surface.				
4							
6		GC	Hard, light brown with yellow brown mottling, GRAVEL with plastic clay matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**			▽	
8			Test pit was terminated at 8.25 feet below ground surface. Standing water was observed at the surface of the excavation.				
10							
12							
14							

▲ Approximate N-value

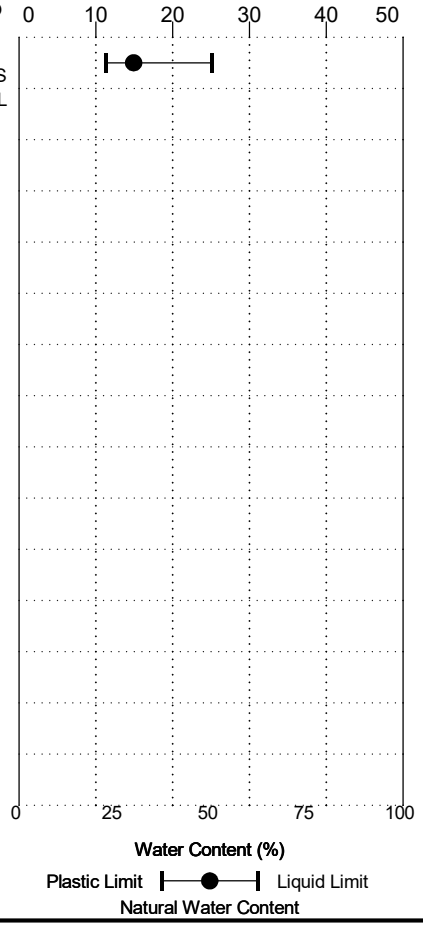


PHOTO OF WEST SIDE OF PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GeoSciences Inc.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT
TP-09

PROJECT NO.: 2015-094-21 FIGURE: A-19

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/16/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION
0		CH	Medium stiff, olive brown, plastic, silty, fat CLAY with trace organics, moist to wet. **(ALLUVIUM)**
2		CH	Medium stiff, yellow brown, plastic, fat CLAY with scattered subrounded volcanoclastic gravel, moist. Gravel is highly oxidized and clay altered. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**
6		GC	Hard, light brown with yellow brown mottling, GRAVEL with plastic clay matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**
8			Test pit was terminated at 7.6 feet below ground surface. Ground water seepage was observed at 1.5 feet below ground surface. Gravelly clay layer creates a restrictive layer to water infiltration.
10			
12			
14			

SAMPLE TYPE | SAMPLE NUMBER | GROUND WATER | OTHER TESTS

▲ Approximate N-value

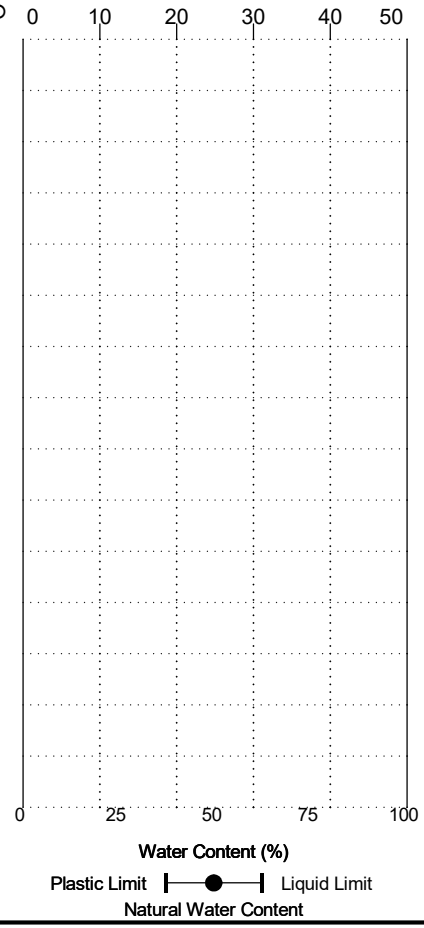


PHOTO OF WEST SIDE OF PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GeoSciences Inc.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT
TP-10

PAGE: 1 of 1

PROJECT NO.: 2015-094-21 FIGURE: A-20

DJH TP 2015-094-21.GPJ 1/21/16

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/16/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION
0		CH	Medium stiff, olive brown, plastic, silty, fat CLAY with trace organics, moist to wet. **(ALLUVIUM)**
2		CH	Stiff, yellow brown, plastic, fat CLAY with scattered subrounded volcanoclastic gravel, moist. Gravel is highly oxidized and clay altered. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**
6		GC	Very stiff to hard, light brown with yellow brown mottling, GRAVEL with plastic clay matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**
8			Test pit was terminated at 8.5 feet below ground surface. Ground water seepage was observed at 1.7 feet below ground surface. Gravelly clay layer creates a restrictive layer to water infiltration.
10			
12			
14			

SAMPLE TYPE | SAMPLE NUMBER | GROUND WATER | OTHER TESTS

▽ GROUND WATER

▲ Approximate N-value

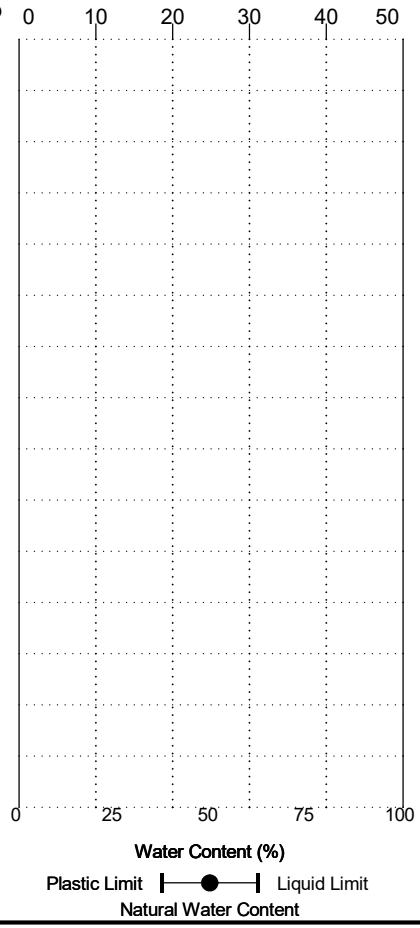


PHOTO OF EAST SIDE OF PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GeoSciences Inc.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT TP-11

PROJECT NO.: 2015-094-21 FIGURE: A-21

DJH TP 2015-094-21.GPJ 1/21/16

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/16/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION
0		CH	Medium stiff, light yellow brown with mottled gray, plastic, silty, fat CLAY with trace organics, moist to wet. **(ALLUVIUM)**
2		CH	Stiff, yellow brown and mottled gray, plastic, fat CLAY with scattered subrounded volcanoclastic gravel, moist. Gravel is highly oxidized and clay altered. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**
4			Density increase to very stiff at 4.5 feet below ground surface.
6			
8		GC	Very stiff to hard, light brown with yellow brown mottling, GRAVEL with plastic clay matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**
10			Test pit was terminated at 8.1 feet below ground surface. Ground water seepage was observed at 1.5 feet below ground surface. Gravelly clay layer creates a restrictive layer to water infiltration.
12			
14			

SAMPLE TYPE / SAMPLE NUMBER / GROUND WATER / OTHER TESTS

S-1

GS
AL

▲ Approximate N-value

0 10 20 30 40 50

0 25 50 75 100

Water Content (%)

Plastic Limit — Liquid Limit

Natural Water Content

PHOTO OF EAST SIDE OF PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT
TP-12

PROJECT NO.: 2015-094-21 FIGURE: A-22

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/16/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER
0		CH	Medium stiff, light yellow brown, plastic, silty, fat CLAY with trace organics, moist to wet. **(ALLUVIUM)**		S-1
2		CH	Stiff, yellow brown, plastic, fat CLAY with scattered subrounded volcanoclastic gravel, moist. Gravel is highly oxidized and clay altered. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**		S-2
4			Density increase to very stiff at 4.6 feet below ground surface.		
6		GC	Hard, light brown with yellow brown mottling, GRAVEL with plastic clay matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**		
8			Test pit was terminated at 7.8 feet below ground surface. No ground water seepage was observed during the exploration.		
10					
12					
14					

GROUND WATER

OTHER TESTS

▲ Approximate N-value

CBR
AL

0 10 20 30 40 50

0 25 50 75 100

Water Content (%)

Plastic Limit — Liquid Limit

Natural Water Content

PHOTO OF EAST SIDE OF PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT
TP-13

PROJECT NO.: 2015-094-21 FIGURE: A-23

EXCAVATION COMPANY: T.E.D.S.
EXCAVATING EQUIPMENT: Kubota Kx 057
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 12/16/15
LOGGED BY: S. Pemble

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	OTHER TESTS
0		CH	Soft, dark brown, fat CLAY with rootlets and decomposed organics, moist. **(TOPSOIL)**		S-1		GS
2		CH	Medium stiff to stiff, light yellow brown, plastic, silty, fat CLAY with trace organics, moist to wet. **(ALLUVIUM)**		S-2	▽	
		CH	Stiff to very stiff, yellow brown, plastic, gravelly, fat CLAY with highly weathered volcanoclastic gravel and cobbles, moist. Gravel and cobbles have 0.25 to 0.5 inch oxidized and clay altered weathering rinds. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**		S-3		
6		GC	Hard, light brown with yellow brown mottling, GRAVEL with plastic clay matrix between gravel and cobbles, moist. Highly oxidized and clay altered volcanoclastic gravel and subrounded to rounded gravel and cobbles. **(REWORKED ALPINE GLACIAL DRIFT/ALLUVIUM)**				
8			Test pit was terminated at 8.5 feet below ground surface. Ground water seepage was observed at 2.9 feet below ground surface. Gravelly clay layer creates a restrictive layer to water infiltration.				
10							
12							
14							

▲ Approximate N-value

0 10 20 30 40 50

0 25 50 75 100

Water Content (%)

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

PHOTO OF EAST SIDE OF PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

South Lewis County Airport
2016/2017 Airport Improvements Project

LOG OF TEST PIT
TP-14

PROJECT NO.: 2015-094-21 FIGURE: A-24

HWA GEOSCIENCES INC.

Client: WHPacific

Project: South Lewis County Airport, Airport Improvements Project

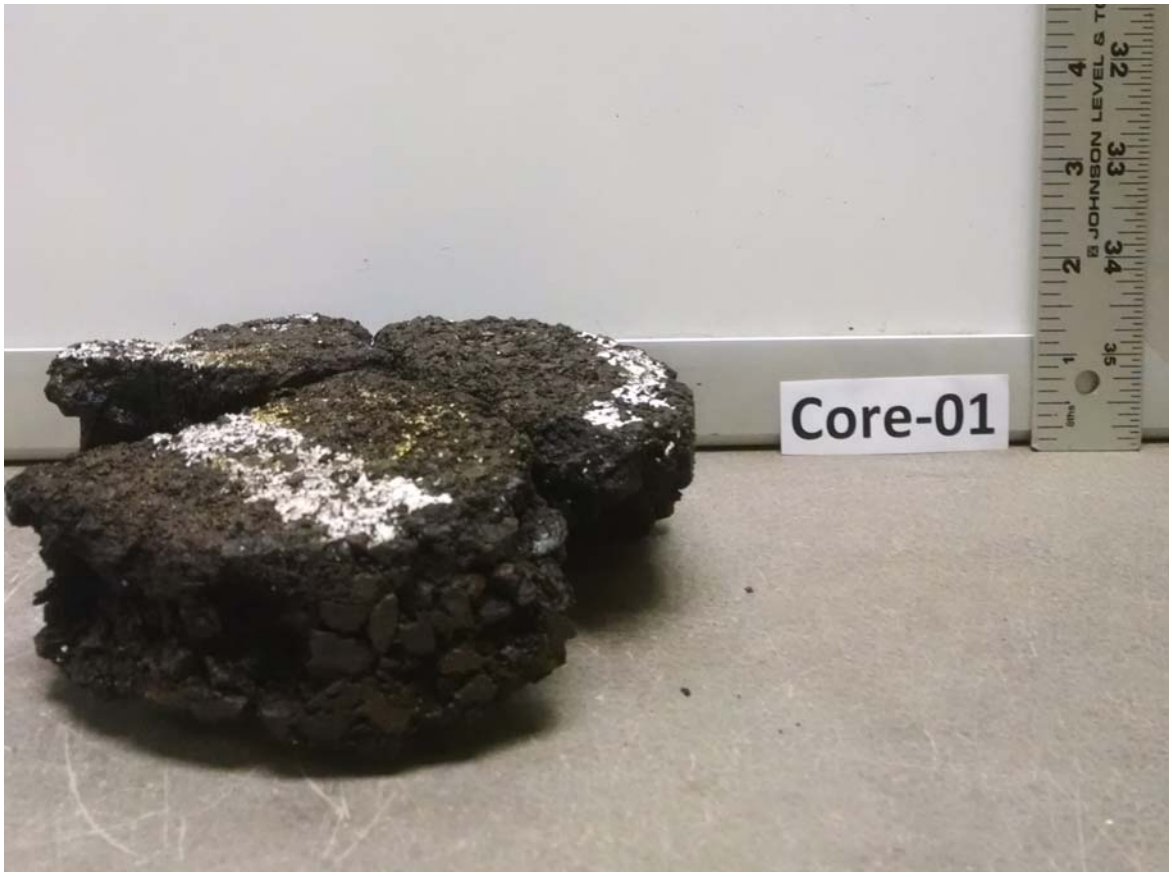
Project No.: 2015-094-21 **Task No:**

Date Sampled: 12/17/15 **Sampled by:** SP

Core Bit Used: 6-inch diameter

Sample Location: See Figure 2

Core Designation: Core-1



Total Wearing Surface Depth: 1.5 inches

Thickness (inches)	Description of Material	Lifts (inches)	Condition
1.5	Hot Mix Asphalt	1.5	Poor
1.5	Crushed Surfacing Top Course (CSTC)	-	Medium dense
6.0	Gravel Borrow Fill	-	Medium dense

Remarks: Cored on crack. Broke into three pieces.

HWA GEOSCIENCES INC.

Client: WHPacific

Project: South Lewis County Airport, Airport Improvements Project

Project No.: 2015-094-21 **Task No:**

Date Sampled: 12/17/15 **Sampled by:** SP

Core Bit Used: 6-inch diameter

Sample Location: See Figure 2

Core Designation: Core-2

Total Wearing Surface Depth: 1.25 inches

Thickness (inches)	Description of Material	Lifts (inches)	Condition
1.25	Hot Mix Asphalt	1.25	Fair
8.75	Gravel Borrow Fill	-	Medium dense

Remarks: Poorly bonded, broke into three pieces during extraction.

HWA GEOSCIENCES INC.

Client: WHPacific

Project: South Lewis County Airport, Airport Improvements Project

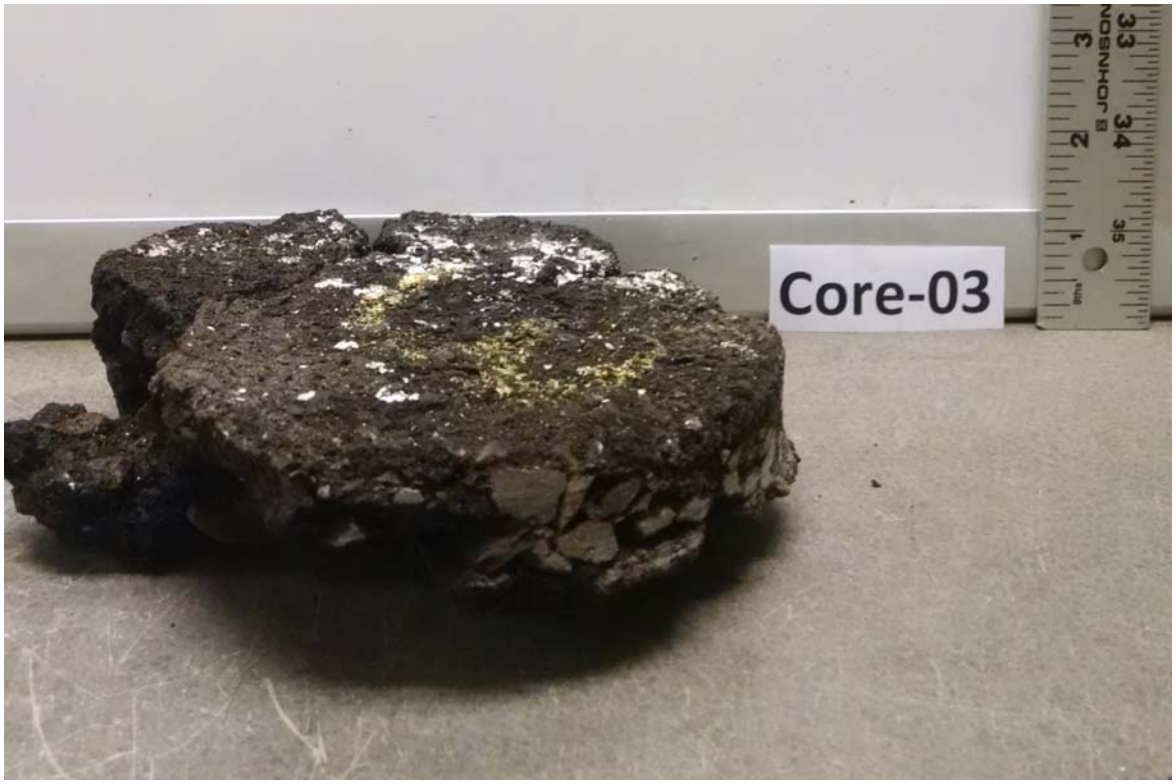
Project No.: 2015-094-21 **Task No:**

Date Sampled: 12/17/15 **Sampled by:** SP

Core Bit Used: 6-inch diameter

Sample Location: See Figure 2

Core Designation: Core-3



Total Wearing Surface Depth: 1.25 inches

Thickness (inches)	Description of Material	Lifts (inches)	Condition
1.25	Hot Mix Asphalt	1.25	Poor
6.75	Gravel Borrow Fill	-	Medium dense

Remarks: Alligator cracked at core location. Crack extends through entire core.

HWA GEOSCIENCES INC.

Client: WHPacific

Project: South Lewis County Airport, Airport Improvements Project

Project No.: 2015-094-21 **Task No:**

Date Sampled: 12/17/15 **Sampled by:** SP

Core Bit Used: 6-inch diameter

Sample Location: See Figure 2

Core Designation: Core-4

Total Wearing Surface Depth: 1.25 inches

Thickness (inches)	Description of Material	Lifts (inches)	Condition
1.25	Hot Mix Asphalt	1.25	Poor
7.25	Gravel Borrow Fill	-	Dense

Remarks: Crack extends through entire core.

HWA GEOSCIENCES INC.

Client: WHPacific

Project: South Lewis County Airport, Airport Improvements Project

Project No.: 2015-094-21 **Task No:**

Date Sampled: 12/17/15 **Sampled by:** SP

Core Bit Used: 6-inch diameter

Sample Location: See Figure 2

Core Designation: Core-5

Total Wearing Surface Depth: 1.0 inches

Thickness (inches)	Description of Material	Lifts (inches)	Condition
1.0	Hot Mix Asphalt	1.0	Poor
6.5	Gravel Borrow Fill	-	Medium dense

Remarks: Local alligator cracking, not cored on crack, however, core broke into six pieces.

HWA GEOSCIENCES INC.

Client: WHPacific

Project: South Lewis County Airport, Airport Improvements Project

Project No.: 2015-094-21 **Task No:**

Date Sampled: 12/17/15 **Sampled by:** SP

Core Bit Used: 6-inch diameter

Sample Location: See Figure 2

Core Designation: Core-6

Total Wearing Surface Depth: 1.25 inches

Thickness (inches)	Description of Material	Lifts (inches)	Condition
1.25	Hot Mix Asphalt	1.0	Fair
7.75	Gravel Borrow Fill	-	Medium dense

Remarks: None.

HWA GEOSCIENCES INC.

Client: WHPacific

Project: South Lewis County Airport, Airport Improvements Project

Project No.: 2015-094-21 **Task No:**

Date Sampled: 12/17/15 **Sampled by:** SP

Core Bit Used: 6-inch diameter

Sample Location: See Figure 2

Core Designation: Core-7

Total Wearing Surface Depth: 3.0 inches

Thickness (inches)	Description of Material	Lifts (inches)	Condition
3.0	Hot Mix Asphalt	3.0	Fair
1.0	Crushed Surfacing Base Course	-	Medium dense
5.0	Gravel Borrow	-	Dense
5.0	Crushed Surfacing Base Course	-	Dense

Remarks: Numerous voids in top 0.25 inches of core. Minor transverse cracking nearby.

HWA GEOSCIENCES INC.

Client: WHPacific

Project: South Lewis County Airport, Airport Improvements Project

Project No.: 2015-094-21 **Task No:**

Date Sampled: 12/17/15 **Sampled by:** SP

Core Bit Used: 6-inch diameter

Sample Location: See Figure 2

Core Designation: Core-8

Total Wearing Surface Depth: 2.5 inches

Thickness (inches)	Description of Material	Lifts (inches)	Condition
2.5	Hot Mix Asphalt	2.5	Poor
8.5	Gravel Borrow Fill	-	Medium dense

Remarks: Cored on longitudinal crack. Local transverse and longitudinal cracking nearby.

HWA GEOSCIENCES INC.

Client: WHPacific

Project: South Lewis County Airport, Airport Improvements Project

Project No.: 2015-094-21 **Task No:**

Date Sampled: 12/17/15 **Sampled by:** SP

Core Bit Used: 6-inch diameter

Sample Location: See Figure 2

Core Designation: Core-9

Total Wearing Surface Depth: 2.5 inches

Thickness (inches)	Description of Material	Lifts (inches)	Condition
2.5	Hot Mix Asphalt	2.5	Poor
12.0	Gravel Borrow Fill	-	Medium dense

Remarks: Core broke into two pieces while drilling. Cored on low severity alligator cracking.

SECTION VI

TECHNICAL SPECIFICATIONS

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Item 01000 FOD Prevention Controls

PART 1: GENERAL

This item shall consist of providing labor and equipment necessary to avoid the possibility for FOD (foreign object damage) to primarily jet aircraft resulting from engine ingestion, engine blast or any high-speed ground operation. **No objects/debris of any visible size** shall be allowed on an active runway, taxiway, shoulder, ramp, road and any other paved surfaces. These surfaces are to be kept clean as work progresses and are to be free of FOD as described above, before these surfaces are opened to aircraft operations.

PART 2: EXECUTION

2.1 EQUIPMENT

Equipment shall include power brooms, vacuum sweepers, and hand tools as necessary.

2.2.1 CONSTRUCTION METHODS

Access/haul routes will be strictly confined to the areas designated on the Construction Site Plan. These routes will be confined to the smallest possible area in order to limit the amount of sweeping and clean-up required. These routes will be clearly marked by the Contractor with signs and cones so that vehicles will not stray from the designated routes. Within airport property, vehicles will not be allowed to travel on gravel or other unpaved surfaces which could be potential sources of FOD.

The Contractor will assign a laborer to inspect each vehicle **entering** the airport construction zone for loose material on the vehicle's exterior or tires and then remove the material before the vehicle proceeds to the work area. To prevent material from falling from the trucks while in transit, loads filled to the top of the side rails will not be allowed on the site.

The Contractor will post a guard at each security gate location along the haul route. In addition to their security duties, the guards will have the responsibility of checking each vehicle en route to the construction area for potential FOD and cleaning as appropriate. It may be possible for the laborers assigned to inspect vehicles to also function as guards.

The Contractor will return all aircraft movement areas to a clean, FOD free state before re-opening those surfaces to aircraft traffic. FOD clean up equipment and methods used by the Contractor will be subject to approval by the Engineer and/or Airport Staff. Equipment judged to be unsuitable by the Engineer will be replaced by the Contractor. No steel bristled brooms will be allowed.

Compliance with the runway closure schedule is critical. To this end, the Contractor will be required to immediately respond to cleanup-equipment breakdowns by having operational equipment on call in case of equipment breakdown.

PART 3: MEASUREMENT AND PAYMENT

Payment for FOD Prevention Controls shall be made at the contract lump sum price for maintaining the FOD prevention program. The price shall be full compensation for all labor, equipment, tools and incidentals necessary to control, remove, and dispose of all FOD materials within work areas and along airport haul routes.

Payment shall be:

Based upon the contract lump sum price for “FOD Prevention Controls” with partial payments that will be prorated as follows:

a. With first pay request, 25%.
b. When 25% or more of the original contract is earned, an additional 25%.
c. When 50% or more of the original contract is earned, an additional 40%.
d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by Section 90-11 of the General Provisions, the final 10%.

Payment will be made under:

Item A1 FOD Prevention Controls – Lump sum

END OF ITEM 01000

Item 01115 Temporary Site Control

PART 1: GENERAL

1.1 SCOPE

This specification outlines safety procedures and regulations to be followed by the Contractor during the course of this work. Construction operations plans are provided in the contract plans as the “Construction Safety and Construction Phasing Plan” (CSPP). This work also includes all traffic control for entrance and exit from highways onto the airport and on site for the control of traffic. The work item "Temporary Site Control" shall consist of furnishing, installing, and removing temporary marking, signing, lighting, and barricades as well as approved site modifications not covered under other bid items, as required during the course of this work. Work shall be in conformance with F.A.A. AC 150/5370-2F “Operational Safety on Airports During Construction, the CSPP, " the "Manual of Uniform Traffic Control," WSDOT Standard Specifications for road, bridge, and municipal construction, and other local laws and ordinances regarding construction site traffic control, maintenance, and restoration.

The CSPP has been developed to mitigate the adverse impacts of construction on aeronautical operations on the airport. Strict adherence to the requirements of the jurisdictions laws and ordinances by all personnel assigned to or visiting the construction site is mandatory for all construction projects. In the event contractor activities are not in conformance with the provisions of the construction operations plan, the contractor shall immediately cease those operations involved in the violation of the provisions of the construction operations plan and conduct a safety meeting. The Owner may direct the contractor, in writing to immediately cease those operations involved in the violation. The contractor shall not resume construction operations until an appropriate action is taken as determined by the Owner and appropriate jurisdiction as appropriate.

The goal is to prevent accidents. The plans shall be continually reviewed and adjusted at the weekly safety meetings with input from various users during the course of the project. Changes to the Contract shall be accomplished by a change order.

1.2 GENERAL SAFETY REQUIREMENTS

The Contractor shall not allow employees, subcontractors, suppliers, or any other unauthorized person to enter or remain in any airport area, which would be hazardous to persons or to aircraft operations.

1.3 CONTRACTOR’S RESPONSIBILITY FOR CONSTRUCTION AND FACILITIES MAINTENANCE

A. Be aware of the types of hazards and marginal conditions.
B. Be aware of and conduct activities so as not to violate any safety.
C. Inspect all Contractor work, construction, and storage areas as often as necessary to be aware of conditions, and
D. Promptly take all steps needed to prevent/remedy any unsafe or potentially unsafe conditions/activities discovered.
E. Upon completion of work and return of all such areas to standard conditions.

PART 2: PRODUCTS

2.1 CLOSURE “X”

The Contractor shall provide runway and taxiway closure “X”. The Contractor shall provide place, maintain, remove closure “X” and provide sand bags or similar materials to secure closure “X” in place.

2.2 BARRICADES

Barricades shall be placed as shown on the plans, around perimeters of construction areas that border areas around any area which may present a hazard. The barricades shall be firmly anchored against overturning from wind or prop wash. No direct payment will be made for furnishing barricades as described or for labor, equipment, and materials necessary to install them. Flashing red lights shall be placed on every plastic barricade during nighttime hours.

PART 3: EXECUTION

3.1 CONSTRUCTION AND MAINTENANCE

A. **GENERAL**

Construction/maintenance activity may not commence prior to issuance of a NOTAM.

3.4 VEHICLE IDENTIFICATION AND PARKING

A. Contractor vehicles and equipment shall be identified by painted or magnetic signing identifying the Contractor's company. See the CSPP for additional requirements.

B. Employee parking shall be confined to the Contractor's staging area shown on the plans.

3.5 CONSTRUCTION SITE ACCESS AND HAUL ROADS

Access to the job site shall be as shown on the plans or as approved by the Owner. The Contractor may remove posts at the entrance to the airport, verify with Engineer. The openings shall be as adjusted as necessary to meet the Contractor's construction needs. Verify with Engineer. Contractor shall provide a guard at the road as needed for traffic control during construction.

Hauling and heavy machinery access across the existing apron is prohibited. Upon project completion, the haul routes shall be reestablished to the pre-construction condition.

PART 4: MEASUREMENT AND PAYMENT

4.1 TEMPORARY SITE CONTROL

Temporary Site Control will be paid for at the contract lump sum price stated in the proposal. This price shall be full compensation for site modifications as approved, furnishing barricades, lights, gate guard, traffic control, pavement marking and signs and other temporary markings and for maintenance of those items during the work, any necessary relocations, and for all labor, equipment, tools and incidentals necessary to complete the item.

No separate payment will temporary site modifications and re-installation of other work that is considered incidental to other applicable bid items.

Payment shall be made at the schedule below for:

Based upon the contract lump sum price for "Temporary Site Control" partial payments will be allowed as follows:

a. With first pay request, 25%.
b. When 25% or more of the original contract is earned, an additional 25%.
c. When 50% or more of the original contract is earned, an additional 40%.
d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by 90-11, the final 10%.

Item A2 Temporary Site Control – Per Lump Sum

END OF ITEM 01115

Item 01406 Construction Surveying

PART 1: GENERAL

1.1 SCOPE

The intent of this section is to define the staking services provided by the Engineer and to set forth the responsibilities of the Contractor for construction staking, surveying, and computation of payment quantities. Survey shall meet the requirements of Section 50-06 of the General Provisions.

PART 3: EXECUTION

3.1 RESPONSIBILITY OF THE ENGINEER

The Engineer will provide reference points in the vicinity of the proposed work for the use by the Contractor in laying out the work and establishing finish grade elevations.

3.2 RESTAKING

Any restaking for disturbed control by the Contractor will be performed by the Contractor, and such restaking shall be at the contractor's expense. If restaking involves efforts by the Engineer, the Contractor shall be charged at the standard rates established by the Engineering firm.

3.3 RESPONSIBILITY OF THE CONTRACTOR

The Contractor shall be responsible for all construction staking not specifically identified above which may be required to insure the project is constructed to the lines and grades shown on the drawings.

The Contractor will be required to furnish all lines, grades, and measurements from the reference points necessary for the proper prosecution and control of the work contracted under these specifications.

Controls and stakes disturbed or suspect of having been disturbed shall be checked and/or reset as directed by the Engineer without additional cost to the Sponsor.

3.4 VERIFICATION

All areas that are staked by the Contractor must be checked by the Engineer prior to beginning any work in the area. The Engineer will make periodic checks of the grades and alignment set by the Contractor. In case of error on part of the Contractor, or his/her employees, resulting in established grades and/or alignment that are not in accordance with the plans or as established by the Engineer, all construction not in accordance with the established grades and/or alignment shall be replaced without additional cost to the Sponsor.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT AND PAYMENT

Payment will be made at the contract lump sum price stated in the Contractor's Proposal. This price shall include all staking, re-staking, checking, materials and equipment necessary to lay out the work as shown on the plans and specified herein.

Based upon the contract lump sum price for "Construction Staking" partial payments will be allowed as follows:

a. With first pay request, 25%.
b. When 25% or more of the original contract is earned, an additional 25%.
c. When 50% or more of the original contract is earned, an additional 40%.

d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by 90-11, the final 10%.

Item A3 Construction Staking – Per Lump Sum

END OF ITEM 01406

Item 01505 Mobilization

PART 1: GENERAL

1.1 SCOPE

Mobilization shall consist of preparatory work and operations, including but not limited to, those necessary for the movement of personnel, equipment, supplies and incidentals to the project site; for the establishment of offices, buildings and other facilities necessary for work on the project; for premiums on bond and insurance for the project and for other work and operations which the contractor must perform or costs he must incur before beginning work on the project.

PART 2: MEASUREMENT AND PAYMENT

2.1 Payment for the performance of the mobilization work as specified and will be made at the contract lump sum amount for the item "Mobilization". Payment shall be made in accordance with the payment schedule outlined in the General Provisions Section 105 Mobilization, 105-2 Basis of Measurement and Payment.

Item A4	Mobilization	Lump Sum (LS)

END OF ITEM 01505

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Item 02050 Demolition

PART 1: GENERAL

1.01 DESCRIPTION OF WORK

The extent and location of the "Demolition" work is indicated on the drawings. The work includes the requirements for the removal, wholly or in part and satisfactory disposal of all utilities, pavements, structures, light fixtures, conduits, wires and other obstructions which are designated to be demolished on the drawings or within these specification.

The Demolition work is included on the drawings for guidance only to indicate typical general construction features of the various types of structures and is not to be construed as definitive or adequate to supplant the actual on-site inspection by the Contractor.

All demolished material except those designated for salvage will become the property of the Contractor and shall be removed from Port property. The Contractor shall dispose of removed material in compliance with all local, regional and federal requirements.

The removal and disposal of all items under this section shall be accomplished without damage to adjacent facilities and other features to remain. All damage to existing facilities to remain in the final project shall be repaired as directed by the Engineer at the Contractor's expense.

During the process of demolition, surface drainage shall be maintained at all times by grading and other means necessary. Temporary drains and drainage ditches shall be installed as needed to intercept or divert surface water which may affect the work.

All items to be removed shall be removed and disposed of prior to final grading and subgrade preparation of the remainder of the site.

All demolition debris on the surface of the active pavements outside the area to be demolished shall be continuously swept clean and completely removed during each working shift.

All demolition debris on the surface of non-active pavements outside the area to be demolished shall be swept clean and completely removed at the end of each work shift.

1.02 JOB CONDITIONS

A. The Contractor is cautioned that critical electrical, communication, and utility lines and facilities exist within the work area. The Contractor shall compete a detailed field locate survey of existing utilities fourteen (14) days prior to starting work in an area. The Contractor shall provide the Owner a mark-up of the existing conditions indicating the findings of the field locate survey of the work area. Should the Contractor's locate survey show additional utilities not indicated on the drawings, the Owner will either require the Contractor to work around the utility, demolish it, or abandon it.

Any additional work by the Contractor to work around a utility that was not indicated on the drawings will be negotiated as covered in the General Conditions. Demolition or abandoning of additional utilities shall be incidental to the unit price for "Demolish Structures and Miscellaneous Utilities." Those utilities which are to remain shall be protected from damage. Any damage to the lines or facilities that are to remain shall be immediately repaired by the Contractor. Refer to paragraph 3.04 of this section for cable splicing requirements.

B. It shall be the contractor's responsibility to provide temporary drainage as described under Section P-156 to intercept and divert surface water to protect the subgrade. It shall also be the Contractor's responsibility to minimize the effect of demolition of construction equipment traffic upon the subgrade. All costs necessary to repair the subgrade as a result of demolition or construction equipment traffic or non-satisfactory temporary drainage shall be borne by the Contractor.

PART 2: PRODUCTS

2.01 GENERAL

Products that are required to accomplish, or to be incorporated into, the work of this section shall be as selected by the Contractor, subject to the approval of the Engineer.

2.02 DEMOLITION ITEMS

A. Structures to be demolished include, but are not limited to:
1. Catch Basins, Manholes, or Vaults
2. Concrete Fuel Pump Pad

B. Utilities to be demolished include, but are not limited to:
1. Storm Sewer Pipes
2. Power Cables, Conduits, and Light Bases

C. Pavement to be demolished includes:
1. Asphalt Concrete Pavement

D. Remove tree larger than 6 inch Diameter measured 1 foot above ground level

PART 3: EXECUTION

3.01 DEMOLITION OF STRUCTURES

A. Completely remove and dispose of designated structures and other obstructions. All pavements designated for removal shall be broken up, loaded and disposed of off airport property by the Contractor. Care shall be taken, in removing the pavement, that damage does not occur to the existing pavement which is to remain in place and that all removals are accomplished by making a near vertical saw cut at the boundaries of the area to be removed. Adjacent materials designated to remain that are damaged by the Contractor due to his operations shall be replaced at no additional cost to the Owner, and to the satisfaction of the Engineer.

B. Existing apron has old hubs pushing the asphalt upward. Sawcut a 2-ft by 2-ft asphalt removal. Pull the old hub, recompact the base course, and then pave back ashalt at a 2-inch lift. Clean and tack pavement edge prior to placing asphalt patch..

C. Approval of Equipment: Due to proximity of the site to active aircraft operation areas, the height and type of equipment to be used will require approval from the Engineer prior to it's use and shall be in accordance with restrictions indicated on the phasing plans.

D. Removal of Asphalt Concrete Pavement: The approximate areas of asphalt concrete pavement removal are indicated on the drawings. Sawcut, full depth, all edges of asphalt concrete pavement prior to removal. All asphalt rubble shall be disposed of off airport property, unless specified to be milled and incorporated into other portions of the work.

E. Removal of Cement Concrete Catch Basins, Manholes, and Vaults: Catch basins, manholes, and vaults to be removed are indicated on the drawings. The structures shall be removed in their entirety. Depressions in the ground left after removing the structures shall be backfilled and compacted in accordance with Section P-152.

3.02 DEMOLITION OF UTILITIES

A. Piping: Remove all piping within the demolition limits except as designated to remain. Cap all cut pipes as indicated on the drawings in accordance with applicable codes. Piping greater than four feet (4') below final grade and twelve inches (12") or less in diameter may be abandoned in place provided that such piping is pumped full of grout.

B. Electrical Items: Remove electrical conduit, fixtures and equipment from the demolition area except those items indicated on the drawings as abandoned in place.

C. Water Lines: Remove and cap water and other utility lines in accordance with applicable codes.

D. Storm Drains: Remove catch basins and manholes in the demolition area.

E. The purpose of the demolition work is to remove from the work area, items that are not to be included in the final project or that would interfere with the development of the final project as specified. If additional items are not listed or indicated on the drawings are encountered, the Contractor shall notify the Engineer immediately.

3.03 DISPOSAL

A. General: All materials, except those indicated as salvage shall upon their demolition become the property of the Contractor and shall be removed and promptly disposed of away from the site. No material shall be disposed of in the embankment. Burning of materials will not be allowed.

B. Cleanup: During and after removal of structures, utilities or improvements, clean and grade the area. There shall be no debris, rubble, or litter left at the site from any of the demolition operations and the site shall be clean.

3.04 CABLE SPLICING

Prior to starting any work on the airfield, the Contractor shall have an approved, certified communication cable splicing company available on a 24-hour emergency basis to make repairs to any cables that may be damaged by the Contractor during this project. The Contractor shall also have approved splice kits on site.

Splices shall be made using compression-type connectors per FAA-C-1391A. The conductors to be spliced shall be powered down and locked in a safe state under the active. The splice shall be competed as expediently as possible and the circuit powered back up and tested for complete and correct operation in the presence of the supervising representative.

After the splice has been proven correct it shall immediately be encased in a hard or pressure cast epoxy resin splice envelope as dictated by cable and/or splice size.

3.05 REMOVE TREE

"Remove Tree" will be for each tree removed with a trunk diameter of 6 inches or greater, measured 1 foot above the ground level. Trunk removal for trees with diameters greater than 6-inches and removal of trees with a trunk diameter less than 6 inches designated for removal, shall be measured and paid for in accordance with "Clearing and Grubbing" bid item.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

4.011 "Removal of Asphalt Pavement Concrete" will be measured on the square yard of pavement removal.

4.012 "Demolish – Miscellaneous Structures" will be measured as a unit and shall include all materials, structures, utilities and pavements shown on the drawings. No separate measurement or payment shall be made for field survey of existing utilities. The cost of this portion of the work shall be included in the payment for the applicable bid items in the proposal. Demolition shall include coring, removal, resetting base course, and patching the asphalt on apron prior to placement of the fog seal.

4.013 "Remove Tree" will be measured for each tree removed with a trunk diameter of 6 inches or greater, measured 1 foot above the ground level. Measurement shall include disposal offsite of the tree along with site restoration not otherwise paid for under clearing and grubbing.

4.02 PAYMENT

4.021 Payment for "Removal of Asphalt Pavement Concrete" will be made per square yard removed and disposed of off airport property. The price shall be full compensation for furnishing all labor, equipment, haul, disposal and incidentals required to accomplish this work.

4.022 Payment for "Demolish – Miscellaneous Structures" will be made at the contract lump sum price as stated in the Proposal and shall be full compensation for furnishing all labor, equipment, haul, disposal and incidentals required to accomplish the demolition or abandonment as specified including delivery of salvage items.

4.023 Payment for "Remove Tree" will be made for each 6 inch diameter or greater tree removed and disposed of off airport property. The price shall be full compensation for furnishing all labor, equipment, haul, disposal and incidentals required to accomplish this work.

Item A5	Removal of Asphalt Pavement Concrete……- Square Yard
Item A6	Demolish – Miscellaneous structures ……..- Lump Sum
Item A7	Remove Tree……- Each

END OF ITEM 02050

Item 02100 Ballast

PART 1: GENERAL

1.1 This work shall consist of furnishing and placing Ballast as noted on the Plans.

PART 2: MATERIALS

2.1 Ballast shall be well-graded, have a maximum size of 2-1/2 inches and shall meet the requirements of WSDOT Standard Specifications Section 9-03.9 Aggregates for Ballast and Crushed Surfacing, Section 9-03.9.1 Ballast.

PART 3: CONSTRUCTION METHODS

3.1 **GENERAL.** The Ballast shall be placed on top of the subgrade separation fabric underneath the subbase where designated on the plans or as directed by the Engineer. The material shall be shaped and thoroughly compacted within the tolerances specified.

3.2 **OPERATION IN PITS.** The material shall be obtained from pits or sources in conformance with Section 3-01 of the Standard Specifications or approved by the Engineer. The material in the pits shall be excavated and handled to produce a uniform and satisfactory product. All work involved in clearing and stripping pits and handling unsuitable material encountered shall be performed by the Contractor. The cost of this work is incidental to this item.

3.3 **PREPARING UNDERLYING COURSE.** Prior to constructing the Ballast, clean the underlying course or subgrade of all foreign substances. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. Correct ruts, or soft yielding spots, in the underlying courses and subgrade areas having inadequate compaction and deviations of the surface from the specified requirements by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses or subgrades containing sands or gravels, as defined in ASTM D2487, the surface shall be stabilized prior to placement of the overlying course at no additional cost to the Owner. Accomplish stabilization by mixing the overlying course material into the underlying course, and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements for the underlying course. Clay, silt or other similar material shall not be mixed into the sand for stabilization. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the overlying course is placed. The course shall be checked and accepted by the Engineer before placing and spreading operations are started. When approved by the Engineer, material may be removed as unsuitable excavation and replaced with uncontaminated existing base course salvaged from existing pavement section excavation.

To protect the subgrade and to ensure proper drainage, the spreading of the Ballast shall begin along the centerline of the pavement on a crowned section or on the high side of pavements with a one-way slope.

3.4 **MATERIALS ACCEPTANCE IN EXISTING CONDITION.** When the entire material is in a uniform and satisfactory condition, the approved material may be moved directly to the spreading equipment for placing. The material may be obtained from gravel pits, stockpiles, or may be produced from a crushing and screening plant with proper blending. The materials from these sources shall meet the requirements for gradation, quality, and consistency. The intent of the specifications is to secure materials that will not require further mixing. Blading or dragging, if necessary, shall be performed to obtain a smooth uniform surface true to line and grade.

3.5 **GENERAL METHODS FOR PLACING.** The Ballast shall be constructed in layers of not less than 4 inches nor more than 12 inches of compacted thickness. The material shall be deposited and

spread evenly to a uniform thickness and width. The material, as spread, shall be of uniform gradation. No material shall be placed in snow or on a soft, muddy, or frozen course.

When more than one layer is required, the construction procedure described here shall apply similarly to each layer.

During the placing and spreading, sufficient caution shall be exercised to prevent the incorporation of subgrade, shoulder, or foreign material in the Ballast.

3.6 FINISHING AND COMPACTING. After spreading or mixing, the Ballast shall be thoroughly compacted by rolling. Sufficient rollers shall be furnished to adequately handle the rate of placing and spreading of the material.

The material shall not be rolled when the underlying course is soft or yielding or when the rolling causes undulation in the Ballast. Along places inaccessible to rollers, the material shall be tamped thoroughly with mechanical tampers.

3.7 THICKNESS CONTROL. The completed thickness of the course(s) shall be in accordance with the thickness and grade indicated on the drawings.

3.8 PROTECTION. Work on Ballast shall not be conducted when the subgrade is wet. The Contractor shall protect and maintain the subgrade from yielding until the material is accepted.

3.9 MAINTENANCE. The Contractor shall maintain the completed course in a satisfactory condition until accepted by the Engineer.

PART 4: METHOD OF MEASUREMENT

4.1 Ballast shall be measured by cubic yard accepted in-place within the limits shown on the drawings and as approved by the Engineer. This measurement shall be full for furnishing, placing and compacting all materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

PART 5: BASIS OF PAYMENT

5.1 Ballast shall be paid at the contract unit price per cubic yard. This price shall be full compensation for furnishing, placing and compacting all materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item A8	Ballast– per cubic yard

END OF ITEM 02100

ITEM 02271 SOIL STABILIZATION FABRIC

PART 1: GENERAL

1.1 DESCRIPTION

A. This item shall consist of furnishing and placing geotextile filter fabrics over an accepted subgrade as shown on the plans, specified in the proposal, or directed by the Engineer.

PART 2: PRODUCTS

2.1 MATERIALS

A. The fabric shall be composed of strong rot-proof polymeric fibers oriented into a stable network such that the fibers retain their relative positions with respect to each other. The fabric shall be free of any chemical treatment or coating which might significantly reduce permeability, and shall have no flaws or defects which could significantly alter its properties. The fabric shall meet the requirements Section 9-33 and of Table 3 Geotextile for Separation or Soil Stabilization from WSDOT Standard Specifications 2016.

B. The Contractor shall provide data, satisfactory to the Engineer, to verify that the geotextile filter fabric selected meets the requirements of these specifications.

PART 3: EXECUTION

3.1 PLACEMENT METHOD

A. Geotextile filter fabric shall be placed parallel to the center line of the roadway, with placement starting at the low side of the super elevation or crown. The fabric shall be sewn together at all longitudinal and transverse edges or overlapped a minimum of twelve (12) inches in all directions. Transverse overlaps shall be made in the direction of the base material placement.

Subsequent material shall be placed in such a way as to not tear, puncture or shift the previously placed geotextile filter fabric. Tears or rips in the fabric shall be patched with fabric lapped a minimum of twelve (12) inches in all directions around the damaged material. Tracked or wheeled equipment shall not be permitted on the geotextile filter fabric covered subgrade.

B. Aggregate ballast, material shall be placed over the geotextile fabric and compacted.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

The geotextile filter fabric shall be measured to the nearest square yard, excluding required overlapping, within the area satisfactorily covered.

4.2 PAYMENT

Payment shall be made at the contract unit price per square yard for Soil Stabilization Fabric, as established in the Proposal. This price shall be full compensation for furnishing all materials and for all operations, hauling and placing of materials, and for all labor, equipment, tools and incidentals necessary to complete the item.

Payment will be made under:

Item A 9 Soil Stabilization Fabric – Square Yard (SY).

END OF SECTION 02271

Item 02578 Pavement Patch Repair & Crack Sealing

PART 1: GENERAL

1.1 SCOPE

This item shall consist of routing, cleaning and filling open cracks in existing asphaltic concrete surfaces and pavement patch repair. This work shall be performed and paid for in accordance with this specification.

PART 2: PRODUCTS

2.1 FILLER MATERIAL

The filler material for crack filling shall be a rubber asphalt product such as Koch 9070 or Koch 9075 “Flex-A-Fill” as manufactured by Koch Materials Co., Crafco Type 221 as manufactured by Crafco, or approved equal. The filler material shall meet ASTM D6690, Type II.

2.2 HERBICIDE

The herbicide to kill the weeds prior to cleaning the cracks shall be Round-up or approved equal.

PART 3: EXECUTION

3.1 EQUIPMENT

All methods employed in performing the work and all equipment, tools, and machinery used for handling the material and executing any part of the work shall be subject to the approval of the Engineer before the work is started, and whenever unsatisfactory, they shall be changed or improved as required. All equipment, tools, machinery and containers must be kept clean and maintained in satisfactory condition.

3.2 CLEANING OF CRACKS

A. GENERAL

Apply herbicide to cracks containing weeds, grass, or other vegetation in advance of crack sealing operations. Allow a waiting period for the herbicide to work in accordance with the manufacturers recommendations.

The cracks shall be cleaned of all loose material, vegetation and other objectionable material. Cleaning shall be accomplished using a heat lance, air pressure, or similar device to loosen and blow the material from the crack. After the cracks are cleaned, the entire paved surface shall be cleaned of foreign material. Care shall be taken not to refill cracks with the foreign material.

The above information is based on current manufacturer’s recommendations for proper installation of specified products listed. If the Contractor wishes to use a different product or preparation method, the material and method must be submitted for approval by the Engineer prior to use.

If settlement occurs in the rubberized asphalt, the cracks shall be refilled until they match or are no lower than 1/8 inch of the finished surface. Any excess buildup of filler material will not be permitted. Any spillage or loose material shall be removed from the surface.

Cracks in areas to receive fog seal shall be cleaned of vegetation and loose material as required above, then filled and leveled with a sealing shoe.

B. CRACK SEAL PREVIOUSLY SEALED CRACKS

All existing sealed cracks to be resealed shall be cleaned of vegetation and any other objectionable material prior to filling. Cleaning shall be accomplished using a heat lance

to liquify the existing material to the satisfaction of the Engineer. Filling of cracks shall be placed in a minimum of two lifts and shall not commence until they are clean and dry.

C. CRACK SEAL ROUTED CRACKS

Existing cracks less than ½ inch in width (either previously sealed or unsealed) identified by the Engineer for routing shall be routed to a minimum depth of 3/8 inch and a maximum depth of ½ inch to create a reservoir for the crack sealant.

If the routing action creates additional raveling, notify the Engineer for further direction. When filling cracks and voids, the filler material shall be placed in one lift to within 1/8 inch of the top of the crack. Re-fill sections that sink.

3.3 WEATHER LIMITS

Crack filler materials shall not be placed/applied when either atmospheric or pavement temperature is 45 degrees F and falling but may be applied when either the atmospheric or pavement temperature is 40 degrees F and rising. Surfaces shall be dry and component materials shall be protected from free moisture.

PART 4: METHOD OF MEASUREMENT

4.1 The quantity of "Crack Cleaning and Sealing" shown on the plans or designated by the Engineer will be measured by the linear foot for cracks which have been cleaned, filled and repaired as specified.

PART 5: BASIS OF PAYMENT

5.1 Payment for "Crack Cleaning and Sealing" will be made at the contract unit price per linear foot based on the actual length of repairs as directed by the Engineer. This price and payment shall be full compensation for all labor, equipment, materials, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item 02578- A10	Crack Cleaning and Sealing – per linear foot

END OF ITEM 02578

Item P-151 Clearing and Grubbing

PART 1: DESCRIPTION

1.1 This item shall consist of clearing or clearing and grubbing, including the disposal of materials, for all areas within the limits designated on the plans or as required by the Engineer.

a. Clearing shall consist of the cutting and removal of all trees, stumps, brush, logs, hedges, the removal of fences and other loose or projecting material from the designated areas. The grubbing of stumps and roots will not be required.

b. Clearing and grubbing shall consist of clearing the surface of the ground of the designated areas of all trees, stumps, down timber, logs, snags, brush, undergrowth, hedges, heavy growth of grass or weeds, fences, structures, debris, and rubbish of any nature, natural obstructions or such material which in the opinion of the Engineer is unsuitable for the foundation of strips, pavements, or other required structures, including the grubbing of stumps, roots, matted roots, foundations, and the disposal from the project of all spoil materials resulting from clearing and grubbing.

PART 2: CONSTRUCTION METHODS

2.1 General. The areas denoted on the plans to be cleared or cleared and grubbed shall be staked on the ground. The clearing and grubbing shall be done at a satisfactory distance in advance of the grading operations.

All spoil materials removed by clearing or by clearing and grubbing shall be disposed of outside the Airport's limits at the Contractor's responsibility, except when otherwise directed by the Engineer. When embankments are constructed, the material shall be placed in accordance with requirements for formation of embankments. Any broken concrete or masonry that is not approved to be used in construction and all other materials not considered suitable for use elsewhere, shall be disposed of by the Contractor. In no case shall any discarded materials be left in windrows or piles adjacent to or within the airport limits. The manner and location of disposal of materials shall be subject to the approval of the Engineer and shall not create an unsightly or objectionable view. When the Contractor is required to locate a disposal area outside the airport property limits, the Contractor shall obtain and file with the Engineer permission in writing from the property owner for the use of private property for this purpose.

Blasting shall not be allowed.

The removal of existing structure and utilities required to permit orderly progress of work shall be accomplished by local agencies, unless otherwise shown on the plans. Whenever a telephone or telegraph pole, pipeline, conduit, sewer, roadway, or other utility is encountered and must be removed or relocated, the Contractor shall advise the Engineer who will notify the proper local authority or owner to secure prompt action.

2.2 Clearing. The Contractor shall clear the staked or indicated area of all objectionable materials. Trees unavoidably falling outside the specified clearing limits must be cut up, removed, and disposed of in a satisfactory manner. To minimize damage to trees that are to be left standing, trees shall be felled toward the center of the area being cleared. The Contractor shall preserve and protect from injury all trees not to be removed. The trees, stumps, and brush shall be cut flush with the original ground surface. The grubbing of stumps and roots will not be required.

Fences shall be removed and disposed of as directed by the Engineer. Fence wire shall be neatly rolled and the wire and posts stored on the airport if they are to be used again, or stored at a location designated by the Engineer if the fence is to remain the property of a local owner or authority.

2.3 Clearing and grubbing. In areas designated to be cleared and grubbed, all stumps, roots, buried logs, brush, grass, and other unsatisfactory materials shall be removed, except where embankments exceeding 3-1/2 feet (105 cm) in depth will be constructed outside of paved areas. For embankments constructed outside of paved areas, all unsatisfactory materials shall be removed, but sound trees,

stumps, and brush can be cut off flush with the original ground and allowed to remain. Tap roots and other projections over 1-1/2 inches (38 mm) in diameter shall be grubbed out to a depth of at least 18 inches (0.5 m) below the finished subgrade or slope elevation.

Heavy vegetative grass areas shall be stripped to a depth of 6-inches and shall be stockpiled separately and placed in the final lift of embankment for areas to be seeded. Soil shall be broken down to a fine material no greater than 1-inch size soil. See T-901 Seeding for additional requirements that supersede this specification for soil treatment.

Any buildings and miscellaneous structures that are shown on the plans to be removed shall be demolished or removed, and all materials shall be disposed of by removal from the site. The cost of removal is incidental to this item. The remaining or existing foundations, wells, cesspools, and like structures shall be destroyed by breaking down the materials of which the foundations, wells, cesspools, etc., are built to a depth at least 2 feet (60 cm) below the existing surrounding ground. Any broken concrete, blocks, or other objectionable material that cannot be used in backfill shall be removed and disposed of at the Contractor's expense. The holes or openings shall be backfilled with acceptable material and properly compacted.

All holes under embankment areas remaining after the grubbing operation shall have the sides of the holes flattened to facilitate filling with acceptable material and compacting as required in Item P-152. The same procedure shall be applied to all holes remaining after grubbing in areas where the depth of holes exceeds the depth of the proposed excavation.

PART 3: METHOD OF MEASUREMENT

3.1 The quantities of clearing or clearing and grubbing as shown by the limits on the plans or as ordered by the Engineer shall be the number of acres or fractions thereof, of land specifically cleared or cleared and grubbed.

PART 4: BASIS OF PAYMENT

4.1 Payment shall be made at the contract unit price per acre for clearing and grubbing. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item A11	Clearing and Grubbing - per acre

END OF ITEM P-151

Item P-152 Excavation, Subgrade, and Embankment

PART 1: DESCRIPTION

1.1 This item covers excavation, disposal, placement, and compaction of all materials within the limits of the work required to construct safety areas, runways, taxiways, aprons, and intermediate areas as well as other areas for drainage, building construction, parking, or other purposes in accordance with these specifications and in conformity to the dimensions and typical sections shown on the plans.

1.2 Classification. All material excavated shall be classified as defined below:

a. Unclassified excavation. Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature which is not otherwise classified and paid for under one of the following items.

b. Rock excavation. Not required.

c. Muck excavation. Not Required.

d. Drainage excavation. Not Required.

e. Borrow excavation. Not Required.

f. Stockpiled Salvage base rock material. Stockpiled material shall consist of approved salvaged base rock material required for the backfill of unsuitable excavation.

1.3 Unsuitable excavation. Any material containing vegetable or organic matter, such as muck, peat, organic silt, or sod shall be considered unsuitable for use in embankment construction. Material, suitable for topsoil may be used on the embankment slope when approved by the Engineer.

PART 2: CONSTRUCTION METHODS

2.1 General. Before beginning excavation, grading, and embankment operations in any area, the area shall be completely cleared and grubbed in accordance with Item P-151.

The suitability of material to be placed in embankments shall be subject to approval by the Engineer. All unsuitable material shall be disposed of in waste areas shown on the plans. All waste areas shall be graded to allow positive drainage of the area and of adjacent areas. The surface elevation of waste areas shall not extend above the surface elevation of adjacent usable areas of the airport, unless specified on the plans or approved by the Engineer.

When the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued and the Engineer notified per subsection 70-20. At the direction of the Engineer, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

Those areas outside of the limits of the pavement areas where the top layer of soil material has become compacted by hauling or other Contractor activities shall be scarified and disked to a depth of 4 inches (100 mm), to loosen and pulverize the soil.

If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures, the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. When such facilities are encountered, the Contractor shall notify the Engineer, who shall arrange for their removal if necessary. The Contractor, at his or her expense, shall satisfactorily repair or pay the cost of all damage to such facilities or structures that may result from any of the Contractor's operations during the period of the contract.

2.2 Excavation. No excavation shall be started until the work has been staked out by the Contractor and the Engineer has obtained from the Contractor, the survey notes of the elevations and measurements of

the ground surface. All areas to be excavated shall be stripped of vegetation and topsoil. Topsoil shall be stockpiled for future use in areas designated on the plans or by the Engineer. All suitable excavated material shall be used in the formation of embankment, subgrade, or other purposes shown on the plans. All unsuitable material shall be disposed of as shown on the plans.

When the volume of the excavation exceeds that required to construct the embankments to the grades indicated, the excess shall be used to grade the areas of ultimate development or disposed as directed by the Engineer. When the volume of excavation is not sufficient for constructing the embankments to the grades indicated, the deficiency shall be obtained from borrow areas.

The grade shall be maintained so that the surface is well drained at all times. When necessary, temporary drains and drainage ditches shall be installed to intercept or divert surface water that may affect the work.

a. Selective grading. When selective grading is indicated on the plans, the more suitable material designated by the Engineer shall be used in constructing the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas so that it can be measured for payment as specified in paragraph 152-3.3.

b. Undercutting. Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for safety areas, subgrades, roads, shoulders, or any areas intended for turf shall be excavated to a minimum depth of 12 inches below the subgrade or to the depth specified by the Engineer. Muck, peat, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be disposed off the airport. The cost is incidental to this item. This excavated material shall be paid for at the contract unit price per cubic yard for ”Unsuitable Excavation.” The excavated area shall be backfilled with suitable material obtained from the grading operations or borrow areas and compacted to specified densities. The necessary backfill will constitute a part of the embankment. Where rock cuts are made, backfill with select material. Any pockets created in the rock surface shall be drained in accordance with the details shown on the plans.

c. Overbreak. Overbreak, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the Engineer. All overbreak shall be graded or removed by the Contractor and disposed of as directed by the Engineer. The Engineer shall determine if the displacement of such material was unavoidable and his or her decision shall be final. Payment will not be made for the removal and disposal of overbreak that the Engineer determines as avoidable. Unavoidable overbreak will be classified as “Unclassified Excavation.”

d. Removal of utilities. The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished by someone other than the Contractor; for example, the utility unless otherwise shown on the plans. All existing foundations shall be excavated at least 2 feet (60 cm) below the top of subgrade or as indicated on the plans, and the material disposed of as directed by the Engineer. All foundations thus excavated shall be backfilled with suitable material and compacted as specified.

e. Compaction requirements. The subgrade under areas to be paved shall be compacted to a depth of **6 inches** and to a density of not less than **95** percent of the maximum density as determined by ASTMD698. The material to be compacted shall be within ±2% of optimum moisture content before being rolled to obtain the prescribed compaction (except for expansive soils).

The in-place field density shall be determined in accordance with ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. Stones or rock fragments larger than 4 inches (100 mm) in their greatest dimension will not be permitted in the top 6 inches of the subgrade. The finished grading operations, conforming to the typical cross-section, shall be completed and maintained at least 1,000 feet ahead of the paving operations or as directed by the Engineer.

All loose or protruding rocks on the back slopes of cuts shall be pried loose or otherwise removed to the slope finished grade line. All cut-and-fill slopes shall be uniformly dressed to the slope, cross-section, and alignment shown on the plans or as directed by the Engineer.

Blasting shall not be allowed.

f. Proof rolling. After compaction is completed, the subgrade area shall be proof rolled with a 20 ton Tandem axle Dual Wheel Dump Truck loaded to the legal limit with tires inflated 80psi in the presence of the Engineer. Apply a minimum of **1** coverage, or as specified by the Engineer, to all paved areas. A coverage is defined as the application of one tire print over the designated area. Soft areas of subgrade that deflect more than 1 inch or show permanent deformation greater than 1 inch shall be removed and replaced with suitable material or reworked to conform to the moisture content and compaction requirements in accordance with these specifications.

2.3 Borrow excavation. Not required.

2.4 Drainage excavation. Not Used. Not required.

2.5 Preparation of embankment area. Where an embankment is to be constructed to a height of 4 feet (1.2 m) or less, all sod and vegetative matter shall be removed from the surface upon which the embankment is to be placed. The cleared surface shall be broken up by plowing or scarifying to a minimum depth of 6 inches (150 mm) and shall then be compacted as indicated in paragraph 152-2.6. When the height of fill is greater than 4 feet (1.2 m), sod not required to be removed shall be thoroughly disked and recompacted to the density of the surrounding ground before construction of embankment.

Sloped surfaces steeper than one (1) vertical to four (4) horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches (300 mm) and compacted as specified for the adjacent fill.

No direct payment shall be made for the work performed under this section. The necessary clearing and grubbing and the quantity of excavation removed will be paid for under the respective items of work.

2.6 Formation of embankments. Embankments shall be formed in successive horizontal layers of not more than 8 inches (200 mm) in loose depth for the full width of the cross-section, unless otherwise approved by the Engineer.

The layers shall be placed, to produce a soil structure as shown on the typical cross-section or as directed by the Engineer. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Earthwork operations shall be suspended at any time when satisfactory results cannot be obtained because of rain, freezing, or other unsatisfactory weather conditions in the field. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. The Contractor shall drag, blade, or slope the embankment to provide surface drainage at all times.

The material in each layer shall be within ±2% of optimum moisture content before rolling to obtain the prescribed compaction. To achieve a uniform moisture content throughout the layer, the material shall be moistened or aerated as necessary. Samples of all embankment materials for testing, both before and after placement and compaction, will be taken for each 1,000 square yards. Based on these tests, the Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content to achieve the specified embankment density.

Rolling operations shall be continued until the embankment is compacted to not less than 95% of maximum density for noncohesive soils, and 90% of maximum density for cohesive soils as determined by ASTMD698. Under all areas to be paved, the embankments shall be compacted to a depth of **6 inches** and to a density of not less than **95** percent of the maximum density as determined by ASTMD698.

On all areas outside of the pavement areas, no compaction will be required on the top 4 inches (100 mm).

The in-place field density shall be determined in accordance with ASTM 6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938**.** Contractor's laboratory shall perform all density tests in the Engineer's presence and provide the test results upon completion to the Engineer for acceptance.

Compaction areas shall be kept separate, and no layer shall be covered by another layer until the proper density is obtained.

During construction of the embankment, the Contractor shall route all construction equipment evenly over the entire width of the embankment as each layer is placed. Layer placement shall begin in the deepest portion of the embankment fill. As placement progresses, the layers shall be constructed approximately parallel to the finished pavement grade line.

When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portion of the embankment and the other material shall be incorporated under the future paved areas. Stones or fragmentary rock larger than 4 inches (100 mm) in their greatest dimensions will not be allowed in the top 6 inches (150 mm) of the subgrade. Rockfill shall be brought up in layers as specified or as directed by the Engineer and the finer material shall be used to fill the voids with forming a dense, compact mass. Rock or boulders shall not be disposed of outside the excavation or embankment areas, except at places and in the manner designated on the plans or by the Engineer.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment as directed in layers not exceeding 2 feet (60 cm) in thickness. Each layer shall be leveled and smoothed with suitable equipment by distribution of spalls and finer fragments of rock. The layer shall not be constructed above an elevation 4 feet (1.2 m) below the finished subgrade.

There will be no separate measurement of payment for compacted embankment. All costs incidental to placing in layers, compacting, discing, watering, mixing, sloping, and other operations necessary for construction of embankments will be included in the contract price for excavation, borrow, or other items.

2.7 Finishing and protection of subgrade. After the subgrade is substantially complete, the Contractor shall remove any soft or other unstable material over the full width of the subgrade that will not compact properly. All low areas, holes or depressions in the subgrade shall be brought to grade with suitable select material. Scarifying, blading, rolling and other methods shall be performed to provide a thoroughly compacted subgrade shaped to the lines and grades shown on the plans.

Grading of the subgrade shall be performed so that it will drain readily. The Contractor shall protect the subgrade from damage and limit hauling over the finished subgrade to only traffic essential for construction purposes. All ruts or rough places that develop in the completed subgrade shall be graded and recompacted.

No subbase, base, or surface course shall be placed on the subgrade until the subgrade has been approved by the Engineer.

2.8 Haul. All hauling will be considered a necessary and incidental part of the work. The Contractor shall include the cost in the contract unit price for the pay of items of work involved. No payment will be made separately or directly for hauling on any part of the work.

2.9 Tolerances. In those areas upon which a subbase or base course is to be placed, the top of the subgrade shall be of such smoothness that, when tested with a 12-foot (3.7-m) straightedge applied parallel and at right angles to the centerline, it shall not show any deviation in excess of 1/2 inch (12 mm), or shall not be more than 0.05 feet (15 mm) from true grade as established by grade hubs. Any deviation in excess of these amounts shall be corrected by loosening, adding, or removing materials; reshaping; and recompacting.

On safety areas, intermediate and other designated areas, the surface shall be of such smoothness that it will not vary more than 0.10 feet (3 mm) from true grade as established by grade hubs. Any deviation in excess of this amount shall be corrected by loosening, adding or removing materials, and reshaping.

2.10 Topsoil. When topsoil is specified or required as shown on the plans or under Item T-905, it shall be salvaged from stripping or other grading operations. The topsoil shall meet the requirements of Item T-905. If, at the time of excavation or stripping, the topsoil cannot be placed in its final section of finished construction, the material shall be stockpiled at approved locations. Stockpiles shall not be placed within 225 feet of runway pavement or 118 feet of taxiway pavement and shall not be placed on areas that

subsequently will require any excavation or embankment fill. If, in the judgment of the Engineer, it is practical to place the salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without stockpiling or further rehandling.

PART 3: METHOD OF MEASUREMENT

3.1 The quantity of Unclassified excavation to be paid for shall be the number of cubic yards measured in its original position. Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed.

3.2 Unsuitable excavation shall be paid for on the basis of the number of cubic yards measured in its original position below subgrade..

3.3 Stockpiled salvage base rock material shall be paid for on the basis of the number of cubic yards measured in place.

3.4 For payment specified by the cubic yard, measurement for all excavation shall be computed by the average end area method. The end area is that bound by the original ground line established by field cross-sections and the final theoretical pay line established by excavation cross-sections shown on the plans, subject to verification by the Engineer. After completion of all excavation operations and prior to the placing of base or subbase material, the final excavation shall be verified by the Contractor by means of field cross-sections taken randomly at intervals not exceeding 500 linear feet.

PART 4: BASIS OF PAYMENT

4.1 "Unclassified Excavation" payment shall be made at the contract unit price per cubic yard (cubic meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

4.2 "Unsuitable Excavation" payment shall be made at the contract unit price per cubic yard (cubic meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

4.3 "Stockpiled salvage base rock material" payment shall be made at the contract unit price per cubic yard (cubic meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item A12	Unclassified Excavation	- per cubic yard
Item A13	Unsuitable Excavation	- per cubic yard
Item A14	Stockpiled Salvaged Base Rock	- per cubic yard

TESTING REQUIREMENTS

ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN-m/m^3))

ASTM D2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

END OF ITEM P-152

Item P-154 Subbase Course

PART 1: DESCRIPTION

1.1 This item shall consist of a subbase course composed of granular materials constructed on a prepared subgrade or underlying course in accordance with these specifications, and in conformity with the dimensions and typical cross-section shown on the plans.

PART 2: MATERIALS

2.1 Materials. The subbase material shall consist of hard durable particles or fragments of granular aggregates. This material will be mixed or blended with fine sand, clay, stone dust, or other similar binding or filler materials produced from approved sources. This mixture must be uniform and shall comply with the requirements of these specifications as to gradation, soil constants, and shall be capable of being compacted into a dense and stable subbase. The material shall be free from vegetative matter, lumps or excessive amounts of clay, and other objectionable or foreign substances. Pit-run material may be used, provided the material meets the gradation requirements specified.

Gradation Requirements

Sieve designation (square openings) as per ASTM C136 and ASTM D422	Percentage by weight passing sieves
3 inch (75 mm)	100
No. 10 (2.0 mm)	20-100
No. 40 (0.450 mm)	5-60
No. 200 (0.075 mm)	0-8

The portion of the material passing the No. 40 (0.450 mm) sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than six (6) when tested in accordance with ASTM D4318.

The material finer than 0.02 mm shall be limited to a maximum of 3% and the maximum allowable material passing the No. 200 sieve shall be reduced from 0-8% to 0-5%. Testing per ASTM D422 will be required for the percentage passing the 0.02 mm particle size once per lot.

2.2 Sampling and testing. Material used on the project shall be sampled per ASTM D75 and tested per ASTM C136 and ASTM C117. Results shall be furnished to the Engineer by the Contractor prior to the start of construction and once per day during construction.

PART 3: CONSTRUCTION METHODS

3.1 General. The subbase course shall be placed where designated on the plans or as directed by the Engineer. The material shall be shaped and thoroughly compacted within the tolerances specified.

Granular subbases which, due to grain sizes or shapes, are not sufficiently stable to support the construction equipment without movement, shall be mechanically stabilized to the depth necessary to provide stability as directed by the Engineer. The mechanical stabilization shall include the addition of a fine-grained medium to bind the particles of the subbase material sufficiently to furnish a bearing strength, so the course will not deform under construction equipment traffic. The addition of the binding medium to the subbase material shall not increase the soil constants of that material above the specified limits.

3.2 Operation in pits. The subbase material shall be obtained from pits or sources that have been approved by the Engineer. The material in the pits shall be excavated and handled to produce a uniform and satisfactory product. All work involved in clearing and stripping pits and handling unsuitable material encountered shall be performed by the Contractor. The cost of this work is incidental to this item.

3.3 Preparing underlying course. Prior to constructing the subbase course, clean the underlying course or subgrade of all foreign substances. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. Correct ruts, or soft yielding spots, in the underlying courses and subgrade areas having inadequate compaction and deviations of the surface from the specified requirements by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses or subgrades containing sands or gravels, as defined in ASTM D2487, the surface shall be stabilized prior to placement of the overlying course. Accomplish stabilization by mixing the overlying course material into the underlying course, and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements for the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the overlying course is placed. The course shall be checked and accepted by the Engineer before placing and spreading operations are started.

To protect the subgrade and to ensure proper drainage, the spreading of the subbase shall begin along the centerline of the pavement on a crowned section or on the high side of pavements with a one-way slope.

3.4 Materials acceptance in existing condition. When the entire subbase material is in a uniform and satisfactory condition at approximately the required moisture content, the approved material may be moved directly to the spreading equipment for placing. The material may be obtained from gravel pits, stockpiles, or may be produced from a crushing and screening plant with proper blending. The materials from these sources shall meet the requirements for gradation, quality, and consistency. The intent of the specifications is to secure materials that will not require further mixing. The moisture content of the material shall be approximately that required to obtain maximum density. Any minor deficiency or excess in moisture content may be corrected by surface sprinkling or by aeration. Some mixing or aeration may be required prior to rolling to obtain the required moisture content. Blading or dragging, if necessary, shall be performed to obtain a smooth uniform surface true to line and grade.

3.5 Plant mixing. When materials from several sources will be blended and mixed, the subbase material shall be processed in a central or travel mixing plant. The subbase material, together with any blended material, shall be thoroughly mixed with the required amount of water. After the mixing is complete, the material shall be transported to and spread on the underlying course without undue loss of moisture content.

3.5.1 Mixed in place. When materials from different sources are to be proportioned and mixed or blended in place, the relative proportions of the components of the mixture shall be as designated by the Engineer.

The subbase material shall be deposited and spread evenly to a uniform thickness and width. Then the binder, filler or other material shall be deposited and spread evenly over the first layer. There shall be as many layers of materials added as the Engineer may direct to obtain the required subbase mixture.

When the required amount of materials have been placed, they shall be thoroughly mixed and blended by means of graders, discs, harrows, rotary tillers, supplemented by other suitable equipment if necessary. The mixing shall continue until the mixture is uniformly blended. Areas of segregated material shall be corrected by the addition of binder or filler material and by thorough remixing. Water shall be uniformly applied prior to and during the mixing operations, if necessary, to maintain the material at its required moisture content. When the mixing and blending has been completed, the material shall be spread in a uniform layer which, when compacted, will meet the requirements of thickness and typical cross-section.

3.6 General methods for placing. The subbase course shall be constructed in layers of not less than 3-inches (75 mm) nor more than 8 inches of compacted thickness. The subbase material shall be deposited and spread evenly to a uniform thickness and width. The material, as spread, shall be of uniform gradation with no pockets of fine or coarse materials. The subbase, unless otherwise permitted by the Engineer, shall not be spread more than 2,000 square yards in advance of the rolling. Any necessary sprinkling shall be kept within this limit. No material shall be placed in snow or on a soft, muddy, or frozen course.

When more than one layer is required, the construction procedure described here shall apply similarly to each layer.

During the placing and spreading, sufficient caution shall be exercised to prevent the incorporation of subgrade, shoulder, or foreign material in the subbase course mixture.

3.7 Finishing and compacting. After spreading or mixing, the subbase material shall be thoroughly compacted by rolling and sprinkling, when necessary. Sufficient rollers shall be furnished to adequately handle the rate of placing and spreading of the subbase course.

The field density of the compacted material shall be at least 100% of the maximum density of laboratory specimens prepared from samples of the subbase material delivered to the jobsite. The laboratory specimens shall be compacted and tested in accordance with D698.The in-place field density shall be determined in accordance with ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. The moisture content of the material at the start of compaction shall be within ±2% of the optimum moisture content. All testing shall be done by the Contractor's laboratory in the presence of the Engineer, and density test results shall be furnished upon completion to the Engineer for acceptance determination.

The course shall not be rolled when the underlying course is soft or yielding or when the rolling causes undulation in the subbase. When the rolling develops irregularities that exceed 3/8 inch when tested with a 12 feet straightedge, the irregular surface shall be loosened and then refilled with the same kind of material as that used in constructing the course and again rolled as required above.

Along places inaccessible to rollers, the subbase material shall be tamped thoroughly with mechanical or hand tampers.

Sprinkling during rolling, if necessary, shall be by equipment approved by the Engineer. Water shall not be added in manner or quantity that allows free water to reach the underlying layer and cause it to become soft.

3.8 Surface tolerance. The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 12-foot straightedge. Take measurements in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 50 foot intervals. Correct deviations exceeding this amount by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.9 Thickness control. The completed thickness of the course(s) shall be in accordance with the thickness and grade indicated on the drawings. The completed course shall not be more than 1/2 inch deficient in thickness nor more than 1/2 inch above or below the established grade. Where any of these tolerances are exceeded, correct such areas by scarifying, adding new material of proper gradation or removing material, and compacting, as directed. Where the measured thickness is 1/2 inch or more thicker than shown, the course will be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements as specified above but within 1/4 inch of the thickness shown. The thickness of the completed subbase course shall be determined by depth tests or sample holes taken at intervals so each test shall represent no more than 500 square yards by survey.

3.10 Protection. Work on subbase course shall not be conducted during freezing temperatures nor when the subgrade is wet. When the subbase material contains frozen material or when the underlying course is frozen, the construction shall be stopped. The Contractor shall protect and maintain the subgrade from yielding until the subbase is accepted.

3.11 Maintenance. The Contractor shall maintain the completed course in a satisfactory condition until accepted by the Engineer.

PART 4: METHOD OF MEASUREMENT

4.1 Subbase course shall be measured by the number of cubic yards of subbase course material placed, compacted, and accepted in the completed course. The quantity of subbase course material shall be measured in final position based upon by means of average end areas on the complete work computed from elevations to the nearest 0.01 foot. On individual depth measurements, thicknesses more than 1/2 inch in excess of that shown on the plans shall be considered as the specified thickness plus 1/2 inch in computing the yardage for payment. Subbase materials shall not be included in any other excavation quantities.

PART 5: BASIS OF PAYMENT

5.1 Payment shall be made at the contract unit price per cubic yard for subbase course. This price shall be full compensation for furnishing all materials; for all preparation, hauling, and placing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item A15	Subbase Course - per cubic yard

TESTING REQUIREMENTS

ASTM C117	Standard Test Method for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4718	Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

END OF ITEM P-154

Item P-156 Temporary Air and Water Pollution, Soil Erosion, and Siltation Control

PART 1: DESCRIPTION

1.1 This item shall consist of temporary control measures as shown on the plans or as ordered by the Engineer during the life of a contract to control water pollution, soil erosion, and siltation through the use of silt fences, berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

Temporary control measures shall be design, installed and maintained to minimize the creation of wildlife attractants that have the potential to attract hazardous wildlife on or near public-use airports.

PART 2: MATERIALS

2.1 Grass. Grass that will not compete with the grasses sown later for permanent cover per Item T-901shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover. Selected grass species shall not create a wildlife attractant.

2.2 Mulches. Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials per ItemT-908. Mulches shall not create a wildlife attractant.

2.3 Fertilizer. Fertilizer shall be a standard commercial grade and shall conform to all Federal and state regulations and to the standards of the Association of Official Agricultural Chemists.

2.4 Slope drains. Slope drains may be constructed of pipe, fiber mats, rubble, Portland cement concrete, bituminous concrete, or other materials that will adequately control erosion.

2.5 Silt fence. Silt fence shall conform to WSDOT Standard Plan I-30.10-02.

2.6 Stabilized Construction Entrance. Stabilized construction entrance shall conform to WSDOT Standard Plan I-80.10-02.

2.7 Storm Drain Inlet Protection. Storm drain inlet protection shall conform to WSDOT Standard Plan I-40.20-00.

2.8 Biodegradable Check Dam. Biodegradable check dam shall conform to WSDOT Standard Plan I-50.20-01, Section 9-14.5(4).

2.9 Erosion Control At Culvert Ends. Erosion control at culvert ends shall conform to WSDOT Standard Plan I-30.20-00.

2.10 Other. All other materials shall meet commercial grade standards and shall be approved by the Engineer before being incorporated into the project.

SECTION 3: CONSTRUCTION REQUIREMENTS

3.1 General. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other Federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

The Engineer shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved.

3.2 Schedule. Prior to the start of construction, the Contractor shall submit schedules for accomplishment of temporary and permanent erosion control work for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the Engineer.

3.3 Construction details. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion may be a problem, clearing and grubbing operations should be scheduled and performed so that grading operations and permanent erosion control features can follow immediately if project conditions permit; otherwise, temporary erosion control measures may be required.

The Engineer shall limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current with the accepted schedule. If seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified as directed by the Engineer.

The Contractor shall provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment as directed by the Engineer. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or directed by the Engineer, the work shall be performed by the Contractor and the cost shall be incidental to this item.

The Engineer may increase or decrease the area of erodible earth material that can be exposed at any time based on an analysis of project conditions.

The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor during the construction period.

Whenever construction equipment must cross watercourses at frequent intervals, temporary structures should be provided.

Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into any waterways, impoundments or into natural or manmade channels.

3.4 Installation, maintenance and removal of silt fences. Silt fences shall extend a minimum of 16 inches (41 cm) and a maximum of 34 inches (86 cm) above the ground surface. Posts shall be set no more than 10 feet (3 m) on center. Filter fabric shall be cut from a continuous roll to the length required minimizing joints where possible. When joints are necessary, the fabric shall be spliced at a support post with a minimum 12-inch (300-mm) overlap and securely sealed. A trench shall be excavated approximately 4 inches (100 mm) deep by 4 inches (100 mm) wide on the upslope side of the silt fence. The trench shall be backfilled and the soil compacted over the silt fence fabric. The Contractor shall remove and dispose of silt that accumulates during construction and prior to establishment of permanent erosion control. The fence shall be maintained in good working condition until permanent erosion control is established. Silt fence shall be removed upon approval of the Engineer.

3.5 Stabilized Construction Entrance. The stabilized construction entrance shall be the area opposite the airport managers office/building parking area that is currently turf. Existing utilities in the area shall be projected. The bid item is for the stripping of existing sod, removed offsite, and placement of 6-inches of ballast for a working platform for the contractor during the construction. Ballast shall be compacted smooth and graded to drain. Material to remain in place upon completion of the project. Measurement shall be for up to 1,000 square yards as approved by the Engineer.

PART 4: METHOD OF MEASUREMENT

4.1 Temporary erosion and pollution control work required will be performed as scheduled or directed by the Engineer. Completed and accepted work will be measured as follows:

a. Installation and removal of silt fence will be measured by the linear foot.

b.. Installation and removal of check dams will be measured by the linear foot

c. Installation of stabilized construction entrance will be measured by the square yard.

4.2 Control work performed for protection of construction areas outside the construction limits, such as borrow and waste areas, haul roads, equipment and material storage sites, and temporary plant sites, will not be measured and paid for directly but shall be considered as a subsidiary obligation of the Contractor.

PART 5: BASIS OF PAYMENT

5.1 Accepted quantities of temporary water pollution, soil erosion, and siltation control work ordered by the Engineer and measured as provided in paragraph 156-4.1 will be paid for under:

Item A16	Silt Fence	- per Linear foot
Item A17	Check Dams	- per Linear foot
Item A18	Stabilized Construction Entrance	- per Square Yard

Where other directed work falls within the specifications for a work item that has a contract price, the units of work shall be measured and paid for at the contract unit price bid for the various items.

Temporary control features not covered by contract items shall be considered incidental to the work.

MATERIAL REQUIREMENTS

ASTM D6461	Standard Specification for Silt Fence Materials
AC 150/5200-33	Hazardous Wildlife Attractants

END OF ITEM P-156

Item P-209 Crushed Aggregate Base Course

PART 1: DESCRIPTION

1.1 This item consists of a base course composed of crushed aggregate base constructed on a prepared course in accordance with these specifications and in conformity to the dimensions and typical cross-sections shown on the plans.

PART 2: MATERIALS

2.1 Crushed aggregate base. Crushed aggregate shall consist of clean, sound, durable particles of crushed stone, crushed gravel, and shall be free from coatings of clay, silt, organic material, or other objectionable materials. Aggregates shall contain no clay lumps or balls. Fine aggregate passing the No. 4 (4.75 mm) sieve shall consist of fines from the coarse aggregate crushing operation. If necessary, fine aggregate may be added to produce the correct gradation. The fine aggregate shall be produced by crushing stone, gravel, that meet the coarse aggregate requirements for wear and soundness.

The coarse aggregate portion, defined as the material retained on the No. 4 (4.75 mm) sieve, shall not have a loss of greater than 45% when tested per ASTM C131. The sodium sulfate soundness loss shall not exceed 12%, or the magnesium sulfate soundness loss shall not exceed 18%, after five cycles, when tested in accordance with ASTM C88. The aggregate shall contain no more than 15%, by weight, of flat, elongated, or flat and elongated particles per ASTM D4791. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than three (3). The aggregate shall have at least 90% by weight of particles with at least two fractured faces and 100% with at least one fractured face per ASTM D5821. The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

a. Sampling and testing for initial aggregate base requirements. Samples shall be taken by the Contractor in the presence of the Engineer. Material shall meet the requirements in paragraph 209-2.1 and 209-2.2. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

2.2 Gradation requirements. The gradation of the aggregate base material shall meet the requirements of the gradation given in the following table when tested per ASTM C117 and ASTM C136. The gradation shall be well graded from coarse to fine as defined by ASTM D2487 and shall not vary from the lower limit on one sieve to the high limit on an adjacent sieve or vice versa. The fraction of material passing the No. 200 (0.075 mm) sieve shall not exceed one-half the fraction passing the No. 40 (0.45 mm) sieve.

The material finer than 0.02 mm shall be limited to a maximum of 3% and the maximum allowable material passing the No. 200 sieve shall be reduced from 0-8% to 0-5%. Testing per ASTM D422 will be required for the percentage passing the 0.02 mm particle size once per lot.

Requirements For Gradation Of Aggregate Base

Sieve Size	Design Range Percentage by Weight	Contractor's Final Gradation	Job Control Grading Band Tolerances for Contractor's Final Gradation Percent
2 inch (50 mm)	100		0
1-1/2 inch (38 mm)	95-100		±5
1 inch (25 mm)	70-95		±8
3/4 inch (19 mm)	55-85		±8
No. 4 (4.75 mm)	30-60		±8

Sieve Size	Design Range Percentage by Weight	Contractor's Final Gradation	Job Control Grading Band Tolerances for Contractor's Final Gradation Percent
No. 40 (0.45 mm)	10-30		±5
No. 200 (0.075 mm)	0-8		±3

The "Job Control Grading Band Tolerances for Contractor's Final Gradation" in the table shall be applied to "Contractor's Final Gradation" to establish a job control grading band. The full tolerance still applies if application of the tolerances results in a job control grading band outside the design range.

a. Sampling and testing for gradation. Gradation tests shall be performed by the Contractor per ASTM C136 and sieve analysis on material passing the No. 200 sieve (75 mm) per ASTM C117. The Contractor shall take at least two aggregate base samples per lot to check the final gradation. Sampling shall be per ASTM D75. The lot will be consistent with the lot size used for density. The samples shall be taken from the in-place, un-compacted material in the presence of the Engineer. Sampling points and intervals will be designated by the Engineer.

PART 3: CONSTRUCTION METHODS

3.1 Preparing underlying subgrade and/or subbase. The underlying subgrade and/or subbase shall be checked and accepted by the Engineer before base course placing and spreading operations begin. Re-proof rolling of the subgrade or proof rolling of the subbase in accordance with P-152, at the Contractor's expense, may be required by the Engineer if the Contractor fails to ensure proper drainage or protect the subgrade and/or subbase. Any ruts or soft, yielding areas due to improper drainage conditions, hauling, or any other cause, shall be corrected before the base course is placed. To ensure proper drainage, the spreading of the base shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

3.2 Production. The aggregate shall be uniformly blended and, when at a satisfactory moisture content per paragraph 209-3.4, the approved material may be transported directly to the spreading equipment.

3.3 Placing. The aggregate base material shall be placed on the prepared underlying subgrade and/or subbase and compacted in layers to the thickness shown on the plans. Work shall progress without interruption. The material shall be deposited and spread in lanes in a uniform layer without segregation to such loose depth that, when compacted, the layer shall have the specified thickness. The aggregate base course shall be constructed in layers of uniform thickness of not less than 3 inches (75 mm) nor more than 6 inches (150 mm) of compacted thickness. The aggregate as spread shall be of uniform grading with no pockets of fine or coarse materials. The aggregate, unless otherwise permitted by the Engineer, shall not be spread more than 2,000 square yards (1700 sq m) in advance of the rolling. Any necessary sprinkling shall be kept within these limits. Care shall be taken to prevent cutting into the underlying layer during spreading. No material shall be placed in snow or on a soft, muddy, or frozen course. The aggregate base material shall be spread by spreader boxes or other approved devices. This equipment shall have positive thickness controls that spread the aggregate in the required amount to avoid or minimize the need for hand manipulation. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

When more than one layer is required, the construction procedure described herein shall apply similarly to each layer.

3.4 Compaction. Immediately after completion of the spreading operations, compact each layer of the base course, as specified, with approved compaction equipment. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade. The moisture content of the material during placing operations shall be within ±2 percentage points of the optimum moisture content as determined by ASTM D6938 using Procedure A.

3.5 Acceptance sampling and testing for density. Aggregate base course shall be accepted for density on a lot basis. A lot will consist of one day's production if it does not exceed 2,400 square yards (2000 sq m). A lot will consist of one-half day's production if a day's production consists of between 2,400 and 4,800 square yards (2000 and 4000 sq m). The Contractor's laboratory shall perform all density tests in the Engineer's presence and provide the test results upon completion daily to the Engineer for acceptance**.**

Each lot shall be divided into two equal sublots. One test shall be made for each sublot and shall consist of the average of two random locations for density determination. Sampling locations will be determined by the Engineer on a random basis per ASTM D3665.

Each lot will be accepted for density when the field density is at least 100% of the maximum density of laboratory specimens. The specimens shall be compacted and tested per ASTM D698. The in-place field density shall be determined per ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. If the specified density is not attained, the entire lot shall be reworked and/or recompacted and two additional random tests made at the Contractor's expense. This procedure shall be followed until the specified density is reached.

3.6 Surface tolerances. After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches (75 mm), reshaped and recompacted to grade until the required smoothness and accuracy are obtained and approved by the Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense. The smoothness and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one layer.

a. Smoothness. The finished surface shall not vary more than 3/8 inch (9 mm) when tested with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously at half the length of the 12-foot (3.7-m) straightedge for the full length of each line on a 50-foot (15-m) grid.

b. Accuracy. The grade and crown shall be measured on a 50-foot (15-m) grid and shall be within +0 and -1/2 inch (12 mm) of the specified grade.

3.7 Thickness control. The thickness of the base course shall be within +0 and -1/2 inch (12 mm) of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Engineer. Tests shall be taken at intervals representing no more than 300 square yards (250 sq m) per test. Sampling locations will be determined by the Engineer per ASTM D3665. Where the thickness is deficient by more than 1/2 inch (12 mm), the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least 3 inches (75 mm), adding new material of proper gradation, and the material shall be blended and recompacted to grade. Additional test holes may be required to identify the limits of deficient areas. The Contractor shall replace, at his expense, base material where depth tests have been taken.

The thickness of the base course may be determined by survey. The survey shall be required before and after placement of the base. The survey interval should be on a 25' by 25' grid, capturing centerlines, grade breaks and edges of the base course.

3.8 Protection. Perform construction when the atmospheric temperature is above 35°F (2°C). When the temperature falls below 35°F (2°C), protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements. When the aggregates contain frozen materials or when the underlying course is frozen or wet, the construction shall be stopped. Hauling equipment may be routed over completed portions of the base course, provided no damage results. Equipment shall be routed over the full width of the base course to avoid rutting or uneven compaction. The Engineer will stop all hauling over completed or partially completed base course when, in the Engineer's opinion, such hauling is causing damage. Any damage to the base course shall be repaired by the Contractor at the Contractor's expense.

3.9 Maintenance. The Contractor shall maintain the base course in a satisfactory condition until the full pavement section is completed and accepted by the Engineer. The surface shall be kept clean and free from foreign material and properly drained at all times. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any base course that is not paved over prior to the onset of winter shall be retested to verify that it still complies with the requirements of this specification. Any area of base course that is damaged shall be reworked or replaced as necessary to comply with this specification.

Equipment used in the construction of an adjoining section may be routed over completed base course, if no damage results and the equipment is routed over the full width of the base course to avoid rutting or uneven compaction.

The Contractor shall remove all survey and grade hubs from the base courses prior to placing any bituminous surface course.

PART 4: METHOD OF MEASUREMENT

4.1 The quantity of crushed aggregate base course will be determined by measurement of the number of cubic yards of material actually constructed and accepted by the Engineer as complying with the plans and specifications. Base materials shall not be included in any other excavation quantities.

PART 5: BASIS OF PAYMENT

5.1 Payment shall be made at the contract unit price per cubic yard for crushed aggregate base course. This price shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, equipment tools, and incidentals necessary to complete the item.

Payment will be made under:

Item A19	Crushed Aggregate Base Course - per cubic yard

TESTING REQUIREMENTS

ASTM C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN-m/m^3))

ASTM D2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D4718	Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

END OF ITEM P-209

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Item P-401 Hot Mix Asphalt (HMA) Pavements

PART 1: DESCRIPTION

1.1 This item shall consist of pavement courses composed of mineral aggregate and asphalt cement binder (asphalt binder) mixed in a central mixing plant and placed on a prepared course in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross-sections shown on the plans. Each course shall be constructed to the depth, typical section, and elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

The work set forth in this section consists of the Contractor's preparation and submittal of an appropriate mix design, including the Contractor's options with respect thereto, discussion of appropriate equipment for use by the Contractor and the placement of pavement composed of mineral aggregate and asphalt cement binder (asphalt binder) mixed in a central mixing plant and placed on a prepared course in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross-sections shown on the plans. Each course shall be constructed to the depth, typical section, and elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

Section headings used in this Section P-401 or any other part of this Contract are for convenience only and shall not be used in the interpretation of this Section P-401 or any other section or subsection of this Contract so as to indicate that phrases or clauses describing standards, tests, equipment, workmanship, material descriptions, characteristics or results to be achieved are confined to the Section heading under which they appear. Any requirement appearing in one location shall be as binding as if appearing in all. It is the intention of this contract that the work will result in an end hot mix asphalt pavement product which is dense, homogeneous, without segregation.

PART 2: MATERIALS

2.1 Aggregate. Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The aggregates should be free of ferrous sulfides, such as pyrite, that would cause "rust" staining that can bleed through pavement markings. The portion retained on the No. 4 (4.75 mm) sieve is coarse aggregate. The portion passing the No. 4 (4.75 mm) sieve and retained on the No. 200 (0.075 mm) sieve is fine aggregate, and the portion passing the No. 200 (0.075 mm) sieve is mineral filler.

a. Coarse aggregate. Coarse aggregate shall consist of sound, tough, durable particles, free from films of matter that would prevent thorough coating and bonding with the bituminous material and free from organic matter and other deleterious substances. The percentage of wear shall not be greater than 40% when tested in accordance with ASTM C131. The sodium sulfate soundness loss shall not exceed 12%, or the magnesium sulfate soundness loss shall not exceed 18%, after five cycles, when tested in accordance with ASTM C88. Clay lumps and friable particles shall not exceed 1.0% when tested in accordance with ASTM C142.

Aggregate shall contain at least 50 percent by weight of individual pieces having two or more fractured faces and 65 percent by weight having at least one fractured face. The area of each face shall be equal to at least 75% of the smallest midsectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces. Fractured faces shall be achieved by crushing.

The aggregate shall not contain more than a total of 8%, by weight, of flat particles, elongated particles, and flat and elongated particles, when tested in accordance with ASTM D4791 with a value of 5:1.

Slag shall be air-cooled, blast furnace slag, and shall have a compacted weight of not less than 70 pounds per cubic foot (1.12 mg/cubic meter) when tested in accordance with ASTM C29.

b. Fine aggregate. Fine aggregate shall consist of clean, sound, tough, durable, angular shaped particles produced by crushing stone, slag, or gravel that meets the requirements for wear and soundness specified for coarse aggregate. The aggregate particles shall be free from coatings of clay, silt, or other objectionable matter.

The fine aggregate, including any blended material for the fine aggregate, shall have a plasticity index of not more than six (6) and a liquid limit of not more than 25 when tested in accordance with ASTM D4318.

The soundness loss shall not exceed 10% when sodium sulfate is used or 15% when magnesium sulfate is used, after five cycles, when tested per ASTM C88.

Clay lumps and friable particles shall not exceed 1.0%, by weight, when tested in accordance with ASTM C142.

Natural (non-manufactured) sand may be used to obtain the gradation of the aggregate blend or to improve the workability of the mix. The amount of sand to be added will be adjusted to produce mixtures conforming to requirements of this specification. The fine aggregate shall not contain more than 15% natural sand by weight of total aggregates. If used, the natural sand shall meet the requirements of ASTM D1073 and shall have a plasticity index of not more than six (6) and a liquid limit of not more than 25 when tested in accordance with ASTM D4318.

The aggregate shall have sand equivalent values of 45 or greater when tested in accordance with ASTM D2419.

c. Sampling. ASTM D75 shall be used in sampling coarse and fine aggregate, and ASTM C183 shall be used in sampling mineral filler.

2.2 Mineral filler. If filler, in addition to that naturally present in the aggregate, is necessary, it shall meet the requirements of ASTM D242.

2.3 Asphalt cement binder. Asphalt cement binder shall conform to ASTM D6373 Performance Grade (PG) **64-22**. A certificate of compliance from the manufacturer shall be included with the mix design submittal.

The supplier's certified test report with test data indicating grade certification for the asphalt binder shall be provided to the Engineer for each load at the time of delivery to the mix plant. A certified test report with test data indicating grade certification for the asphalt binder shall also be provided to the Engineer for any modification of the asphalt binder after delivery to the mix plant and before use in the HMA.

2.4 Preliminary material acceptance. Prior to delivery of materials to the job site, the Contractor shall submit certified test reports to the Engineer for the following materials:

a. Coarse aggregate:

(1) Percent of wear

(2) Soundness

(3) Clay lumps and friable particles

(4) Percent fractured faces

(5) Flat and elongated particles

(6) Unit weight of slag

b. Fine aggregate:

(1) Liquid limit and Plasticity index

(2) Soundness

(3) Clay lumps and friable particles

(4) Percent natural sand

(5) Sand equivalent

c. Mineral filler.

d. Asphalt binder. Test results for asphalt binder shall include temperature/viscosity charts for mixing and compaction temperatures.

The certifications shall show the appropriate ASTM tests for each material, the test results, and a statement that the material meets the specification requirement.

The Engineer may request samples for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

2.5 Anti-stripping agent. Any anti-stripping agent or additive if required shall be heat stable, shall not change the asphalt cement viscosity beyond specifications, shall contain no harmful ingredients, shall be added in recommended proportion by approved method, and shall be a material approved by the Department of Transportation of the State in which the project is located.

PART 3: COMPOSITION

3.1 Composition of mixture. The HMA mix shall be composed of a mixture of well-graded aggregate, filler and anti-strip agent if required, and asphalt binder. The several aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF).

3.2 Job mix formula (JMF). No hot-mixed asphalt (HMA) for payment shall be produced until a JMF has been approved in writing by the Engineer. The asphalt mix-design and JMF shall be prepared by an accredited laboratory that meets the requirements of paragraph 401-3.4. The HMA shall be designed using procedures contained in Asphalt Institute MS-2 Mix Design Manual, 7th Edition. Samples shall be prepared at various asphalt contents and compacted using the gyratory compactor in accordance with ASTM D6925.

Tensile strength ratio (TSR) of the composite mixture, as determined by ASTM D4867, shall not be less than 75 when tested at a saturation of 70-80% or an anti-stripping agent shall be added to the HMA, as necessary, to produce a TSR of not less than 75 when tested at a saturation of 70-80%. If an anti-strip agent is required, it shall be provided by the Contractor at no additional cost to the Owner.

The JMF shall be submitted in writing by the Contractor at least **30** days prior to the start of paving operations. The JMF shall be developed within the same construction season using aggregates currently being produced.

The submitted JMF shall be stamped or sealed by the responsible professional Engineer of the laboratory and shall include the following items as a minimum:

a. Percent passing each sieve size for total combined gradation, individual gradation of all aggregate stockpiles and percent by weight of each stockpile used in the job mix formula.

b. Percent of asphalt cement.

c. Asphalt performance grade and type of modifier if used.

d. Number of gyrations**.**

e. Laboratory mixing temperature.

f. Laboratory compaction temperature.

g. Temperature-viscosity relationship of the PG asphalt cement binder showing acceptable range of mixing and compaction temperatures; and for modified binders include supplier recommended mixing and compaction temperatures.

h. Plot of the combined gradation on a 0.45 power gradation curve.

i. Graphical plots of air voids, voids in the mineral aggregate, and unit weight versus asphalt content**.**

j. Specific Gravity and absorption of each aggregate.

k. Percent natural sand.

l. Percent fractured faces.

m. Percent by weight of flat particles**,** elongated particles, and flat and elongated particles (and criteria).

n. Tensile Strength Ratio (TSR).

o. Anti-strip agent (if required).

p. Date the JMF was developed. Mix designs that are not dated or which are from a prior construction season shall not be accepted.

The Contractor shall submit to the Engineer the results of verification testing of three (3) asphalt samples prepared at the optimum asphalt content. The average of the results of this testing shall indicate conformance with the JMF requirements specified in Tables 1 and 3.

When the project requires asphalt mixtures of differing aggregate gradations, a separate JMF and the results of JMF verification testing shall be submitted for each mix.

The JMF for each mixture shall be in effect until a modification is approved in writing by the Engineer. Should a change in sources of materials be made, a new JMF must be submitted within 15 days and approved by the Engineer in writing before the new material is used. After the initial production JMF has been approved by the Engineer and a new or modified JMF is required for whatever reason, the subsequent cost of the Engineer's approval of the new or modified JMF, including a new test strip when required by the engineer, will be borne by the Contractor. There will be no time extension given or considerations for extra costs associated with the stoppage of production paving or restart of production paving due to the time needed for the Engineer to approve the initial, new or modified JMF.

The Gyratory Design Criteria applicable to the project shall meet the criteria specified in Table 1.

Table 1. Gyratory Compaction Criteria

Test Property	Value
Number of compactor gyrations	50
Air voids (%)	3.5
Percent voids in mineral aggregate, minimum	See Table 2

Table 2. Minimum Percent Voids In Mineral Aggregate (VMA)

Aggregate (See Table 3)	Minimum VMA
Gradation 2	15%

The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified in Table 3 when tested in accordance with ASTM C136 and ASTM C117.

The gradations in Table 3 represent the limits that shall determine the suitability of aggregate for use from the sources of supply; be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa.

Table 3. Aggregate - HMA Pavements

Sieve Size	Percentage by Weight Passing Sieve
1 inch (25 mm)	-
3/4 inch (19 mm)	100
1/2 inch (12 mm)	79-99
3/8 inch (9 mm)	68-88
No. 4 (4.75 mm)	48-68
No. 8 (2.36 mm)	33-53
No. 16 (1.18 mm)	20-40
No. 30 (0.60 mm)	14-30
No. 50 (0.30 mm)	9-21
No. 100 (0.15 mm)	6-16
No. 200 (0.075 mm)	3-6
Asphalt Percent:	
Stone or gravel	5.0-7.5
Slag	6.5-9.5

The aggregate gradations shown are based on aggregates of uniform specific gravity. The percentages passing the various sieves shall be corrected when aggregates of varying specific gravities are used, as indicated in the Asphalt Institute MS-2 Mix Design Manual, 7th Edition.

3.3 Reclaimed asphalt pavement (RAP). RAP shall not be used.

3.4 Job mix formula (JMF) laboratory. The Contractor's laboratory used to develop the JMF shall be accredited in accordance with ASTM D3666. The laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for developing the JMF must be listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction.

3.5 Test section. Prior to full production, the Contractor shall prepare and place a quantity of HMA according to the JMF. The amount of HMA shall be sufficient to construct a test section 300 long and 25 wide, placed in two lanes, with a longitudinal cold joint, and shall be of the same depth specified for the construction of the course which it represents. A cold joint for this test section is an exposed construction joint at least four (4) hours old or whose mat has cooled to less than 160°F (71°C). The cold joint must be cut back using the same procedure that will be used during production in accordance with 401-4.13. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment used in construction of the test section shall be the same type and weight to be used on the remainder of the course represented by the test section.

The test section shall be evaluated for acceptance as a single lot in accordance with the acceptance criteria in paragraph 401-5.1 and 401-5.2. The test section shall be divided into equal sublots. As a minimum the test section shall consist of three (3) sublots.

The test section shall be considered acceptable if (1)mat density, air voids, and joint density are 90% or more within limits, (2) gradation and asphalt content are within the action limits specified in paragraphs 401-6.5a and 5b, and (3) the voids in the mineral aggregate are within the limits of Table 2.

The test results shall be acceptable for the work to continue. If all of the test results meet the specified requirements, the test section shall remain as part of the project pavement. If test section is not considered acceptable, the test section shall be removed and replaced at no cost to the Owner and another test section shall be constructed.

If the initial test section should prove to be unacceptable, the necessary adjustments to the job mix formula, plant operation, placing procedures, and/or rolling procedures shall be made. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable test section has been constructed and accepted in writing by the Engineer. Once an acceptable test section has been placed, payment for the test section that meets specification requirements shall be made in accordance with paragraph 401-8.1

Job mix control testing shall be performed by the Contractor at the start of plant production and in conjunction with the calibration of the plant for the JMF. If aggregates produced by the plant do not satisfy the gradation requirements or produce a mix that meets the JMF, it will be necessary to reevaluate and redesign the mix using plant-produced aggregates. Specimens shall be prepared and the optimum asphalt content determined in the same manner as for the original JMF tests.

Contractor will not be allowed to place the test section until the Contractor Quality Control Program, showing conformance with the requirements of Paragraph 401-6.1, has been approved, in writing, by the Engineer.

PART 4: CONSTRUCTION METHODS

4.1 Weather limitations. The HMA shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 4. The temperature requirements may be waived by the Engineer, if requested; however, all other requirements including compaction shall be met.

Table 4. Surface Temperature Limitations of Underlying Course

Mat Thickness	Base Temperature (Minimum)	
	°F	°C
3 inches (7.5 cm) or greater	40	4
Greater than 2 inches (50 mm) but less than 3 inches (7.5 cm)	45	7

4.2 HMA plant. Plants used for the preparation of HMA shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M156 with the following changes:

Requirements for all plants include:

a. Truck scales. The HMA shall be weighed on approved scales furnished by the Contractor, or on certified public scales at the Contractor's expense. Scales shall be inspected and sealed as often as the Engineer deems necessary to assure their accuracy. Scales shall conform to the requirements of the General Provisions, subsection 90-01.

In lieu of scales, and as approved by the Engineer, HMA weight may be determined by the use of an electronic weighing system equipped with an automatic printer that weighs the total HMA production and as often thereafter as requested by the Engineer.

b. Testing facilities. The Contractor shall ensure laboratory facilities are provided at the plant for the use of the Engineer. The lab shall have sufficient space and equipment so that both testing representatives (Engineer's and Contractor's) can operate efficiently. The lab shall meet the requirements of ASTM D3666 including all necessary equipment, materials, calibrations, current reference standards to comply with the specifications and a masonry saw with diamond blade for trimming pavement cores and samples.

The plant testing laboratory shall have a floor space area of not less than 200 square feet (18.5 sq m), with a ceiling height of not less than 7-1/2 feet (2 m). The laboratory shall be weather tight, sufficiently heated in cold weather, air-conditioned in hot weather to maintain temperatures for testing purposes of 70°F ±5°F (21°C ±2.3°C). The plant testing laboratory shall be located on the plant site to provide an unobstructed view, from one of its windows, of the trucks being loaded with the plant mix materials. In addition, the facility shall include the minimum:

(1) Adequate artificial lighting.

(2) Electrical outlets sufficient in number and capacity for operating the required testing equipment and drying samples.

(3) A minimum of two (2) Underwriter's Laboratories approved fire extinguishers of the appropriate types and class.

(4) Work benches for testing.

(5) Desk with chairs and file cabinet.

(6) Sanitary facilities convenient to testing laboratory.

(7) Exhaust fan to outside air.

(8) Sink with running water.

Failure to provide the specified facilities shall be sufficient cause for disapproving HMA plant operations.

Laboratory facilities shall be kept clean, and all equipment shall be maintained in proper working condition. The Engineer shall be permitted unrestricted access to inspect the Contractor's laboratory facility and witness quality control activities. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

c. Inspection of plant. The Engineer, or Engineer's authorized representative, shall have access, at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant: verifying weights, proportions, and material properties; and checking the temperatures maintained in the preparation of the mixtures.

d. Storage bins and surge bins. The HMA stored in storage and surge bins shall meet the same requirements as HMA loaded directly into trucks and may be permitted under the following conditions:

(1) Stored in non-insulated bins for a period of time not to exceed three (3) hours.

(2) Stored in insulated bins for a period of time not to exceed eight (8) hours.

If the Engineer determines that there is an excessive amount of heat loss, segregation, or oxidation of the HMA due to temporary storage, no temporary storage will be allowed.

4.3 Hauling equipment. Trucks used for hauling HMA shall have tight, clean, and smooth metal beds. To prevent the HMA from sticking to the truck beds, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other material approved by the Engineer. Petroleum products shall not be used for coating truck beds. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers shall be securely fastened.

4.3.1 Material transfer vehicle (MTV). Material transfer vehicles are not required.

4.4 HMA pavers. HMA pavers shall be self-propelled with an activated heated screed, capable of spreading and finishing courses of HMA that will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the HMA uniformly in front of the screed without

segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

If, during construction, it is found that the spreading and finishing equipment in use leaves tracks or indented areas, or produces other blemishes in the pavement that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued and satisfactory equipment shall be provided by the Contractor.

4.4.1 Automatic grade controls. The HMA paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices that will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within ±0.1%.

The controls shall be capable of working in conjunction with any of the following attachments:

a. Ski-type device of not less than 30 feet (9 m) in length.

b. Taut string-line (wire) set to grade.

c. Short ski or shoe.

d. Laser control.

4.5 Rollers. Rollers of the vibratory, steel wheel, and pneumatic-tired type shall be used. They shall be in good condition, capable of operating at slow speeds to avoid displacement of the HMA. The number, type, and weight of rollers shall be sufficient to compact the HMA to the required density while it is still in a workable condition.

All rollers shall be specifically designed and suitable for compacting HMA concrete and shall be properly used. Rollers that impair the stability of any layer of a pavement structure or underlying soils shall not be used. Depressions in pavement surfaces caused by rollers shall be repaired by the Contractor at their own expense.

The use of equipment that causes crushing of the aggregate will not be permitted.

4.6. Density device. The Contractor shall have on site a density gauge during all paving operations in order to assist in the determination of the optimum rolling pattern, type of roller and frequencies, as well as to monitor the effect of the rolling operations during production paving. The Contractor shall also supply a qualified technician during all paving operations to calibrate the gauge and obtain accurate density readings for all new HMA. These densities shall be supplied to the Engineer upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.

4.7 Preparation of asphalt binder. The asphalt binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the asphalt binder to the mixer at a uniform temperature. The temperature of unmodified asphalt binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall not exceed 325°F (160°C) when added to the aggregate. The temperature of modified asphalt binder shall be no more than 350°F (175°C) when added to the aggregate.

4.8 Preparation of mineral aggregate. The aggregate for the HMA shall be heated and dried. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. The temperature of the aggregate and mineral filler shall not exceed 350°F (175°C) when the asphalt binder is added. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

4.9 Preparation of HMA. The aggregates and the asphalt binder shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D2489, for each

individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95% of coated particles. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all HMA upon discharge shall not exceed 0.5%.

4.10 Preparation of the underlying surface. Immediately before placing the HMA, the underlying course shall be cleaned of all dust and debris. A tack coat is required between the existing pavement surface and the new hot mix asphalt, including milled surfaces; between layers of each lift of hot mix asphalt; and at any vertical surfaces that the new hot mix asphalt will be placed against including cold joints. Tack coat must be applied in accordance with Item P-603.

4.11 Laydown plan, transporting, placing, and finishing. Prior to the placement of the HMA, the Contractor shall prepare a laydown plan for approval by the Engineer. This is to minimize the number of cold joints in the pavement. The laydown plan shall include the sequence of paving laydown by stations, width of lanes, temporary ramp locations, and laydown temperature. The laydown plan shall also include estimated time of completion for each portion of the work (that is, milling, paving, rolling, cooling, etc.). Modifications to the laydown plan shall be approved by the Engineer.

The HMA shall be transported from the mixing plant to the site in vehicles conforming to the requirements of paragraph 401-4.3. Deliveries shall be scheduled so that placing and compacting of HMA is uniform with minimum stopping and starting of the paver. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to atmospheric temperature.

The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose for the first lift of all runway and taxiway pavements. Successive lifts of HMA surface course may be placed using a ski, or laser control per paragraph 401-4.4.1, provided grades of the first lift of HMA surface course meet the tolerances of paragraphs 401-5.2b(6) as verified by a survey. Contractor shall survey each lift of HMA surface course and certify to Engineer that every lot of each lift meets the grade tolerances of paragraph 401-5.2b(6) before the next lift can be placed.

The initial placement and compaction of the HMA shall occur at a temperature suitable for obtaining density, surface smoothness, and other specified requirements but not less than 250°F (121°C).

Edges of existing HMA pavement abutting the new work shall be saw cut and carefully removed as shown on the drawings and coated with asphalt tack coat before new material is placed against it.

Upon arrival, the HMA shall be placed to the full width by a HMA paver. It shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the HMA mat. Unless otherwise permitted, placement of the HMA shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The HMA shall be placed in consecutive adjacent strips having a minimum width of **10.0** feet except where edge lanes require less width to complete the area. Additional screed sections shall not be attached to widen paver to meet the minimum lane width requirements specified above unless additional auger sections are added to match. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot ; however, the joint in the surface top course shall be at the centerline of crowned pavements. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course.

Transverse joints in adjacent lanes shall be offset a minimum of 10 feet .

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the HMA may be spread and luted by hand tools.

Areas of segregation in the surface course, as determined by the Engineer, shall be removed and replaced at the Contractor’s expense. The area shall be removed by saw cutting and milling a minimum of 2 inches (50 mm) deep. The area to be removed and replaced shall be a minimum width of the paver and a minimum of 10 feet (3 m) long.

4.12 Compaction of HMA. After placing, the HMA shall be thoroughly and uniformly compacted by power rollers. The surface shall be compacted as soon as possible when the HMA has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in

compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once.

Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross-section, and the required field density is obtained. To prevent adhesion of the HMA to the roller, the wheels shall be equipped with a scraper and kept properly moistened but excessive water will not be permitted.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with approved power driven tampers. Tampers shall weigh not less than 275 pounds , have a tamping plate width not less than 15 inches (38 cm), be rated at not less than 4,200 vibrations per minute, and be suitably equipped with a standard tamping plate wetting device.

Any HMA that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching shall not be allowed.

4.13 Joints. The formation of all joints shall be made in such a manner as to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

The roller shall not pass over the unprotected end of the freshly laid HMA except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be coated with an asphalt tack coat before placing any fresh HMA against the joint.

Longitudinal joints which have been left exposed for more than four (4) hours; the surface temperature has cooled to less than 175°F (80°C**)**; or are irregular, damaged, uncompacted or otherwise defective shall be cut back 3 inches to 6 inches to expose a clean, sound, uniform vertical surface for the full depth of the course. All cutback material shall be removed from the project. Asphalt tack coat or other product approved by the Engineer shall be applied to the clean, dry joint, prior to placing any additional fresh HMA against the joint. Any laitance produced from cutting joints shall be removed by vacuuming and washing. The cost of this work shall be considered incidental to the cost of the HMA.

4.14 Saw-cut grooving. If shown on the plans, saw cut grooves shall be provided as specified in Item P-621.

4.15 Diamond grinding. When required, diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the pavement. The saw blades shall be 1/8-inch (3-mm) wide and there shall be a minimum of 55 to 60 blades per 12 inches (300 mm) of cutting head width; the actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Each machine shall be capable of cutting a path at least 3 feet (0.9 m) wide. Equipment that causes ravels, aggregate fractures, spalls or disturbance to the pavement will not be permitted. The depth of grinding shall not exceed 1/2 inch (13mm) and all areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. Areas that have been ground will be sealed with a P-608 surface treatment as directed by the Engineer. It may be necessary to seal a larger area to avoid surface treatment creating any conflict with runway or taxiway markings.

4.16 Nighttime paving requirements. Paving during nighttime construction shall require the following:

a. All paving machines, rollers, distribution trucks and other vehicles required by the Contractor for his operations shall be equipped with artificial illumination sufficient to safely complete the work.

b. Minimum illumination level shall be twenty (20) horizontal foot-candles and maintained in the following areas:

(1) An area of 30 feet wide by 30 feet long immediately behind the paving machines during the operations of the machines.

(2) An area 15 feet wide by 30 feet long immediately in front and back of all rolling equipment, during operation of the equipment.

(3) An area 15 feet wide by 15 feet long at any point where an area is being tack coated prior to the placement of pavement.

c. As partial fulfillment of the above requirements, the Contractor shall furnish and use, complete artificial lighting units with a minimum capacity of 3,000 watt electric beam lights, affixed to all equipment in such a way to direct illumination on the area under construction.

d. A lighting plan must be submitted by the Contractor and approved by the Engineer prior to the start of any nighttime work.

PART 5: MATERIAL ACCEPTANCE

5.1 Acceptance sampling and testing. Unless otherwise specified, all acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Engineer at no cost to the Contractor except that coring as required in this section shall be completed and paid for by the Contractor.

Testing organizations performing these tests shall be accredited in accordance with ASTM D3666. The laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for acceptance sampling and testing must be listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction. All equipment in Contractor furnished laboratories shall be calibrated by an independent testing organization prior to the start of operations at the Contractor's expense.

a. Hot mixed asphalt. Plant-produced HMA shall be tested for air voids on a lot basis. Sampling shall be from material deposited into trucks at the plant or from trucks at the job site. Samples shall be taken in accordance with ASTM D979.

A standard lot shall be equal to one day's production or 2000 tons whichever is smaller. If the day's production is expected to exceed 2000 tons (1814 metric tons), but less than 4000 tons, the lot size shall be 1/2 day's production. If the day's production exceeds 4000 tons, the lot size shall be an equal sized fraction of the day's production, but shall not exceed 2000 tons.

Where more than one plant is simultaneously producing HMA for the job, the lot sizes shall apply separately for each plant.

(1) Sampling. Each lot will consist of four equal sublots. Sufficient HMA for preparation of test specimens for all testing will be sampled by the Engineer on a random basis, in accordance with the procedures contained in ASTM D3665. Samples will be taken in accordance with ASTM D979.

The sample of HMA may be put in a covered metal tin and placed in an oven for not less than 30 minutes nor more than 60 minutes to stabilize to compaction temperature. The compaction temperature of the specimens shall be as specified in the JMF.

(2) Testing. Air voids will be determined by the Engineer in accordance with ASTM D3203. One set of laboratory compacted specimens will be prepared for each sublot in accordance with ASTM D6925 at the number of gyrations required by paragraph 401-3.2, Table 1. Each set of laboratory compacted specimens will consist of three test specimens prepared from the same sample.

Prior to testing, the bulk specific gravity of each test specimen shall be measured by the Engineer in accordance with ASTM D2726 using the procedure for laboratory-prepared thoroughly dry specimens for use in computing air voids and pavement density.

For air voids determination, the theoretical maximum specific gravity of the mixture shall be measured one time for each sublot in accordance with ASTM D2041. The value used in the air voids computation for each sublot shall be based on theoretical maximum specific gravity measurement for the sublot.

(3) Acceptance. Acceptance of plant produced HMA for air voids shall be determined by the Engineer in accordance with the requirements of paragraph 401-5.2b.

b. In-place HMA. HMA placed in the field shall be tested for mat and joint density on a lot basis. A standard lot shall be equal to one day's production or 2000 tons whichever is smaller. If the day's production

is expected to exceed 2000 tons, but less than 4000 tons, the lot size shall be 1/2 day's production. If the day's production exceeds 4000 tons, the lot size shall be an equal sized fraction of the day's production, but shall not exceed 2000 tons.

(1) Mat density. The lot size shall be the same as that indicated in paragraph 401-5.1a and shall be divided into four equal sublots. One core of finished, compacted HMA shall be taken by the Contractor from each sublot. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D3665. Cores for mat density shall not be taken closer than one foot from a transverse or longitudinal joint.

(2) Joint density. The lot size shall be the total length of longitudinal joints constructed by a lot of HMA as defined in paragraph 401-5.1a. The lot shall be divided into four equal sublots. One core of finished, compacted HMA shall be taken by the Contractor from each sublot. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D3665. All cores for joint density shall be taken centered on the joint. The minimum core diameter for joint density determination shall be 5 inches.

(3) Sampling. Samples shall be neatly cut with a diamond core drill bit. Samples will be taken in accordance with ASTM D979. The minimum diameter of the sample shall be 5 inches . Samples that are clearly defective, as a result of sampling, shall be discarded and another sample taken. The Contractor shall furnish all tools, labor, and materials for cutting samples, cleaning, and filling the cored pavement. Cored pavement shall be cleaned and core holes shall be filled in a manner acceptable to the Engineer and within one day after sampling. Laitance produced by the coring operation shall be removed immediately.

The top most lift of HMA shall be completely bonded to the underlying layer. If any of the cores reveal that the surface is not bonded to the layer immediately below the surface then additional cores shall be taken as directed by the Engineer in accordance with paragraph 401-5.1b to determine the extent of any delamination. All delaminated areas shall be completely removed by milling to the limits and depth and replaced as directed by the Engineer at no additional cost.

(4) Testing. The bulk specific gravity of each cored sample will be measured by the Engineer in accordance with ASTM D2726. Samples will be taken in accordance with ASTM D979. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each sublot sample by the average bulk specific gravity of all laboratory prepared specimens for the lot, as determined in paragraph 401-5.1a(2). The bulk specific gravity used to determine the joint density at joints formed between different lots shall be the lowest of the bulk specific gravity values from the two different lots.

(5) Acceptance. Acceptance of field placed HMA for mat density will be determined by the Engineer in accordance with the requirements of paragraph 401-5.2b(1). Acceptance for joint density will be determined by the Engineer in accordance with the requirements of paragraph 401-5.2b(3).

c. Partial lots. When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot, or when the Contractor and Engineer agree in writing to allow overages or other minor tonnage placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

The last batch produced where production is halted will be sampled, and its properties shall be considered as representative of the particular sublot from which it was taken. In addition, an agreed to minor placement will be sampled, and its properties shall be considered as representative of the particular sublot from which it was taken. Where three sublots are produced, they shall constitute a lot. Where one or two sublots are produced, they shall be incorporated into the next lot, and the total number of sublots shall be used in the acceptance plan calculation, that is, n = 5 or n = 6, for example. Partial lots at the end of asphalt production on the project shall be included with the previous lot. The lot size for field placed material shall correspond to that of the plant material, except that, in no cases, shall less than three (3) cored samples be obtained, that is, n = 3.

5.2 Acceptance criteria.

a. General. Acceptance will be based on the following characteristics of the HMA and completed pavement as well as the implementation of the Contractor Quality Control Program and test results:

(1) Air voids

(2) Mat density

(3) Joint density

(4) Thickness

(5) Smoothness

(6) Grade

Mat density and air voids will be evaluated for acceptance in accordance with paragraph 401-5.2b(1). Joint density will be evaluated for acceptance in accordance with paragraph 401-5.2b(3).

Thickness will be evaluated by the Engineer for compliance in accordance with paragraph 401-5.2b(4). Acceptance for smoothness will be based on the criteria contained in paragraph 401-5.2b(5). Acceptance for grade will be based on the criteria contained in paragraph 401-5.2b(7).

The Engineer may at any time, reject and require the Contractor to dispose of any batch of HMA which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or improper mix temperature. Such rejection may be based on only visual inspection or temperature measurements. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Engineer, and if it can be demonstrated in the laboratory, in the presence of the Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price. Engineer shall review and approve laboratory testing plan.

b. Acceptance criteria.

(1) Mat density and air voids. Acceptance of each lot of plant produced material for mat density and air voids shall be based on the percentage of material within specification limits (PWL). If the PWL of the lot equals or exceeds 90%, the lot shall be acceptable. Acceptance and payment shall be determined in accordance with paragraph 401-8.1.

(2) Joint density. Acceptance of each lot of plant produced HMA for joint density shall be based on the PWL. If the PWL of the lot is equal to or exceeds 90%, the lot shall be considered acceptable. If the PWL is less than 90%, the Contractor shall evaluate the reason and act accordingly. If the PWL is less than 80%, the Contractor shall cease operations and until the reason for poor compaction has been determined. If the PWL is less than 71%, the pay factor for the lot used to complete the joint shall be reduced by five (5) percentage points. This lot pay factor reduction shall be incorporated and evaluated in accordance with paragraph 401-8.1.

(3) Thickness. Thickness of each lift of surface course shall be evaluated by the Engineer for compliance to the requirements shown on the plans. Measurements of thickness shall be made by the Engineer using the cores extracted for each sublot for density measurement. The maximum allowable deficiency at any point shall not be more than 1/4 inch less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, shall not be less than the indicated thickness. Where the thickness tolerances are not met, the lot or sublot shall be corrected by the Contractor at his expense by removing the deficient area and replacing with new pavement. The Contractor, at his expense, may take additional cores as approved by the Engineer to circumscribe the deficient area.

(4) Smoothness. The final surface shall be free from roller marks. After the final rolling, but not later than 24 hours after placement, the surface of each lot shall be tested in both longitudinal and transverse directions for smoothness to reveal all surface irregularities exceeding the tolerances specified. The Contractor shall furnish paving equipment and employ methods that produce a surface for each pavement lot having an average profile index meeting the requirements of paragraph 401-8.1d when evaluated with a profilograph; and the finished surface course of the pavement shall not vary more than 1/4 inch (6mm) when evaluated with a 12-foot (3.7m) straightedge. When the surface course smoothness exceeds specification tolerances which cannot be corrected by diamond grinding of the surface course, full depth removal and replacement of surface course corrections shall be to the limit of the longitudinal placement. Corrections involving diamond grinding will be subject to the final pavement thickness tolerances specified. The Contractor shall apply a surface treatment per Item P-608 or P-609 to all areas that have been subject to grinding as directed by the Engineer.

(a) Transverse measurements. Transverse measurements will be taken for each lot placed. Transverse measurements will be taken perpendicular to the pavement centerline each 50 feet or more often as determined by the Engineer.

(i) Testing shall be continuous across all joints, starting with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. Smoothness readings will not be made across grade changes or cross slope transitions; at these transition areas, the straightedge position shall be adjusted to measure surface smoothness and not design grade or cross slope transitions. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. High spots on final surface course > 1/4 inch (6mm) in transverse direction shall be corrected with diamond grinding per paragraph 401-4.15 or by removing and replacing full depth of surface course. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The area corrected by grinding should not exceed 10% of the total area and these areas shall be retested after grinding.

(ii) The joint between lots shall be tested separately to facilitate smoothness between lots. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface, with half the straightedge on one side of the joint and the other half of the straightedge on the other side of the joint. Measure the maximum gap between the straightedge and the pavement surface in the area between these two high points. One measurement shall be taken at the joint every 50 feet (15m) or more often if directed by the Engineer. Deviations on final surface course > 1/4 inch (6mm) in transverse direction shall be corrected with diamond grinding per paragraph 401-4.15 or by removing and replacing full depth of surface course. Each measurement shall be recorded and a copy of the data shall be furnished to the Engineer at the end of each days testing.

(b) Longitudinal measurements. Longitudinal measurements will be taken for each lot placed. Longitudinal tests will be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6m); and at the third points of paving lanes when widths of paving lanes are 20 ft (6m) or greater.

(i) Longitudinal Short Sections. Longitudinal Short Sections are when the longitudinal lot length is less than 200 feet and areas not requiring a profilograph. When approved by the Engineer, the first and last 15 feet of the lot can also be considered as short sections for smoothness. The finished surface shall not vary more than 1/4 inch when evaluated with a 12-foot straightedge. Smoothness readings will not be made across grade changes or cross slope transitions; at these transition areas, the straightedge position shall be adjusted to measure surface smoothness and not design grade or cross slope transitions. Testing shall be continuous across all joints, starting with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. Deviations on final surface course > 1/4 inch (6mm) in longitudinal direction will be corrected with diamond grinding per paragraph 401-4.15 or by removing and replacing full depth of surface course. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The area corrected by grinding should not exceed 10% of the total area and these areas shall be retested after grinding.

(5) Grade. Grade shall be evaluated on the first day of placement and then as a minimum, every **day thereafter** to allow adjustments to paving operations if measurements do not meet specification requirements. The Contractor must submit the survey data to the Engineer by the following day after measurements have been taken. The finished surface of the pavement shall not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm). The finished grade of each lot will be determined by running levels at intervals of 50 feet (15 m) or less longitudinally and all breaks in grade transversely (not to exceed 50 feet (15 m)) to determine the elevation of the completed pavement. The Contractor shall pay the cost of surveying of the level runs that shall be performed by a licensed surveyor. The documentation, stamped and signed by a licensed surveyor, shall be provided by the Contractor to the Engineer. The lot size shall be 2,000 square yards (m^2). When more than 15% of all the

measurements within a lot are outside the specified tolerance, or if any one shot within the lot deviates 3/4 inch or more from planned grade, the Contractor shall remove the deficient area to the depth of the final course plus 1/2 inch of pavement and replace with new material. Skin patching shall not be permitted. Isolated high points may be ground off provided the course thickness complies with the thickness specified on the plans. The surface of the ground pavement shall have a texture consisting of grooves between 0.090 and 0.130 inches wide. The peaks and ridges shall be approximately 1/32 inch (1 mm) higher than the bottom of the grooves. The pavement shall be left in a clean condition. The removal of all of the slurry resulting from the grinding operation shall be continuous The grinding operation should be controlled so the residue from the operation does not flow across other lanes of pavement. High point grinding will be limited to 15 square yards. Areas in excess of 15 square yards will require removal and replacement of the pavement in accordance with the limitations noted above. The Contractor shall apply a surface treatment per P-608 to all areas that have been subject to grinding.

c. Percentage of material within specification limits (PWL). The PWL shall be determined in accordance with procedures specified in Section 110 of the General Provisions. The specification tolerance limits (L) for lower and (U) for upper are contained in Table 5.

Table 5. Gyratory Acceptance Limits For Air Voids, Density

TEST PROPERTY	Specification Tolerance	
	L	U
Air Voids Total Mix (%)	2	5
Mat Density (%)	96.3	101.3
Joint Density (%)	93.3	-

d. Outliers. All individual tests for mat density and air voids shall be checked for outliers (test criterion) in accordance with ASTM E178, at a significance level of 5%. Outliers shall be discarded, and the PWL shall be determined using the remaining test values.The criteria in Table 5 is based on production processes which have a variability with the following standard deviations: Surface Course Mat Density (%), 1.30; Base Course Mat Density (%), 1.55; Joint Density (%), 2.1.

The Contractor should note that (1) 90 PWL is achieved when consistently producing a surface course with an average mat density of at least 98% with 1.30% or less variability, (2) 90 PWL is achieved when consistently producing a base course with an average mat density of at least 97.5% with 1.55% or less variability, and (3) 90 PWL is achieved when consistently producing joints with an average joint density of at least 96% with 2.1% or less variability.

5.3 Resampling pavement for mat density.

a. General. Resampling of a lot of pavement will only be allowed for mat density, and then, only if the Contractor requests same, in writing, within 48 hours after receiving the written test results from the Engineer. A retest will consist of all the sampling and testing procedures contained in paragraphs 401-5.1b and 401-5.2b(1). Only one resampling per lot will be permitted.

(1) A redefined PWL shall be calculated for the resampled lot. The number of tests used to calculate the redefined PWL shall include the initial tests made for that lot plus the retests.

(2) The cost for resampling and retesting shall be borne by the Contractor.

b. Payment for resampled lots. The redefined PWL for a resampled lot shall be used to calculate the payment for that lot in accordance with Table 6.

c. Outliers. Check for outliers in accordance with ASTM E178, at a significance level of 5%.

PART 6: CONTRACTOR QUALITY CONTROL

6.1 General. The Contractor shall develop a Quality Control Program in accordance with Section 100 of the General Provisions. The program shall address all elements that affect the quality of the pavement including, but not limited to:

a. Mix design

b. Aggregate grading

c. Quality of materials

d. Stockpile management

e. Proportioning

f. Mixing and transportation

g. Placing and finishing

h. Joints

i. Compaction

j. Surface smoothness

k. Personnel

l. Laydown plan

The Contractor shall perform quality control sampling, testing, and inspection during all phases of the work and shall perform them at a rate sufficient to ensure that the work conforms to the contract requirements, and at minimum test frequencies required by paragraph 401-6.3 and Section 100 of the General Provisions. As a part of the process for approving the Contractor's plan, the Engineer may require the Contractor's technician to perform testing of samples to demonstrate an acceptable level of performance.

No partial payment will be made for materials that are subject to specific quality control requirements without an approved plan.

6.2 Contractor testing laboratory. The lab shall meet the requirements of ASTM D3666 including all necessary equipment, materials, and current reference standards to comply with the specifications.

6.3 Quality control testing. The Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to these specifications and as set forth in the approved Quality Control Program. The testing program shall include, but not necessarily be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

a. Asphalt content. A minimum of two asphalt content tests shall be performed per lot in accordance with ASTM D6307 or ASTM D2172 if the correction factor in ASTM D6307 is greater than 1.0. The asphalt content for the lot will be determined by averaging the test results.

b. Gradation. Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with ASTM D5444, ASTM C136, and ASTM C117.

c. Moisture content of aggregate. The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C566.

d. Moisture content of HMA. The moisture content shall be determined once per lot in accordance with ASTM D1461.

e. Temperatures. Temperatures shall be checked, at least four times per lot, at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the HMA at the plant, and the HMA at the job site.

f. In-place density monitoring. The Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in accordance with ASTM D2950.

g. Additional testing. Any additional testing that the Contractor deems necessary to control the process may be performed at the Contractor's option.

h. Monitoring. The Engineer reserves the right to monitor any or all of the above testing.

6.4 Sampling. When directed by the Engineer, the Contractor shall sample and test any material that appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

6.5 Control charts. The Contractor shall maintain linear control charts both for individual measurements and range (that is, difference between highest and lowest measurements) for aggregate gradation, asphalt content, and VMA. The VMA for each sublot will be calculated and monitored by the Quality Control laboratory.

Control charts shall be posted in a location satisfactory to the Engineer and shall be kept current. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the Engineer may suspend production or acceptance of the material.

a. Individual measurements. Control charts for individual measurements shall be established to maintain process control within tolerance for aggregate gradation, asphalt content, and VMA. The control charts shall use the job mix formula target values as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

Control Chart Limits For Individual Measurements		
Sieve	**Action Limit**	**Suspension Limit**
3/4 inch (19 mm)	±6%	±9%
1/2 inch (12 mm)	±6%	±9%
3/8 inch (9 mm)	±6%	±9%
No. 4 (4.75 mm)	±6%	±9%
No. 16 (1.18 mm)	±5%	±7.5%
No. 50 (0.30 mm)	±3%	±4.5%
No. 200 (0.075 mm)	±2%	±3%
Asphalt Content	±0.45%	±0.70%
VMA	-1.00%	-1.50%

b. Range. Control charts for range shall be established to control process variability for the test parameters and Suspension Limits listed below. The range shall be computed for each lot as the difference

between the two test results for each control parameter. The Suspension Limits specified below are based on a sample size of n = 2. Should the Contractor elect to perform more than two tests per lot, the Suspension Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

Control Chart Limits Based On Range (Based On n = 2)	
Sieve	**Suspension Limit**
1/2 inch (12 mm)	11%
3/8 inch (9 mm)	11%
No. 4 (4.75 mm)	11%
No. 16 (1.18 mm)	9%
No. 50 (0.30 mm)	6%
No. 200 (0.075 mm)	3.5%
Asphalt Content	0.8%

c. Corrective Action. The Contractor Quality Control Program shall indicate that appropriate action shall be taken when the process is believed to be out of tolerance. The Plan shall contain sets of rules to gauge when a process is out of control and detail what action will be taken to bring the process into control. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

(1) One point falls outside the Suspension Limit line for individual measurements or range; or

(2) Two points in a row fall outside the Action Limit line for individual measurements.

6.6 Quality control reports. The Contractor shall maintain records and shall submit reports of quality control activities daily, in accordance with the Contractor Quality Control Program described in General Provisions, Section 100.

PART 7: METHOD OF MEASUREMENT

7.1 Measurement. HMA shall be measured by the number of tons of HMA used in the accepted work. Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage, adjusted by the Engineer for material remaining or wasted and not used for pavement.

PART 8: BASIS OF PAYMENT

8.1 Payment. Payment for a lot of HMA meeting all acceptance criteria as specified in paragraph 401-5.2 shall be made based on results of tests for mat density and air voids. Payment for acceptable lots shall be adjusted according to paragraph 401-8.1a for mat density and air voids and 401-8.1c for smoothness, subject to the limitation that:

a. The total project payment for plant mix bituminous concrete pavement shall not exceed **100** percent of the product of the contract unit price and the total number of tons of HMA used in the accepted work (See Note 1 under Table 6).

b. The price shall be compensation for furnishing all materials, for all preparation, mixing, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

c. Basis of adjusted payment. The pay factor for each individual lot shall be calculated in accordance with Table 6. A pay factor shall be calculated for both mat density and air voids. The lot pay factor shall be the higher of the two values when calculations for both mat density and air voids are 100% or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either mat density or air voids is 100% or higher. The lot pay factor shall be the lower of the two values when calculations for both mat density and air voids are less than 100%. If PWL for joint density is less than 71 percent then the lot pay factor shall be reduced by 5% but be no higher than 95%.

For each lot accepted, the adjusted contract unit price shall be the product of the lot pay factor for the lot and the contract unit price. Payment shall be subject to the total project payment limitation specified in paragraph 401-8.1. Payment in excess of 100% for accepted lots of HMA shall be used to offset payment for accepted lots of bituminous concrete pavement that achieve a lot pay factor less than 100%.

Table 6. Price adjustment schedule[1]

Percentage of material within specification limits (PWL)	Lot pay factor (percent of contract unit price)
96 – 100	106
90 – 95	PWL + 10
75 – 89	0.5 PWL + 55
55 – 74	1.4 PWL – 12
Below 55	Reject [2]

[1] Although it is theoretically possible to achieve a pay factor of 106% for each lot, actual payment above 100% shall be subject to the total project payment limitation specified in paragraph 401-8.1.

[2] The lot shall be removed and replaced. However, the Engineer may decide to allow the rejected lot to remain. In that case, if the Engineer and Contractor agree in writing that the lot shall not be removed, it shall be paid for at 50% of the contract unit price and the total project payment shall be reduced by the amount withheld for the rejected lot.

HMA placed above the specified grade shall not be included in the quantities for payment.

8.1.1. Payment. Payment will be made under:

Item A22 HMA - Bituminous Surface Course - per ton

TESTING REQUIREMENTS

ASTM C29 Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate

ASTM C88 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM C117 Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C127 Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate

ASTM C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C183	Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement
ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D979	Standard Practice for Sampling Bituminous Paving Mixtures
ASTM D1073	Standard Specification for Fine Aggregate for Bituminous Paving Mixtures
ASTM D2172	Standard Test Method for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D1461	Standard Test Method for Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D2041	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2489	Standard Practice for Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D2726	Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D2950	Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D3203	Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D4867	Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D5444	Standard Test Method for Mechanical Size Analysis of Extracted Aggregate
ASTM D6084	Standard Test Method for Elastic Recovery of Bituminous Materials by Ductilometer
ASTM D6307	Standard Test Method for Asphalt Content of Hot Mix Asphalt by Ignition Method
ASTM D6752	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method
ASTM D6926	Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus
ASTM D6925	Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the SuperPave Gyratory Compactor.ASTM E11 Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
ASTM E178	Standard Practice for Dealing with Outlying Observations
ASTM E1274	Standard Test Method for Measuring Pavement Roughness Using a Profilograph
AASHTO T030	Standard Method of Test for Mechanical Analysis of Extracted Aggregate

AASHTO T110	Standard Method of Test for Moisture or Volatile Distillates in Hot Mix Asphalt (HMA)
AASHTO T275	Standard Method of Test for Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Paraffin-Coated Specimens
AASHTO M156	Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
AASHTO T329	Standard Method of Test for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method
Asphalt Institute Handbook MS-26,	Asphalt Binder
Asphalt Institute MS-2	Mix Design Manual, 7th Edition

MATERIAL REQUIREMENTS

ASTM D242	Standard Specification for Mineral Filler for Bituminous Paving Mixtures
ASTM D946	Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D3381	Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D4552	Standard Practice for Classifying Hot-Mix Recycling Agents
ASTM D6373	Standard Specification for Performance Graded Asphalt Binder

END OF ITEM P-401

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Item P-602 Bituminous Prime Coat

DESCRIPTION

602-1.1 This item shall consist of an application of bituminous material on the prepared base course in accordance with these specifications and in reasonably close conformity to the lines shown on the plans.

MATERIALS

602-2.1 Bituminous material. The bituminous material shall be an emulsified asphalt indicated in ASTM D3628 as a bituminous application for prime coat appropriate to local conditions or as designated by the Engineer.

CONSTRUCTION METHODS

602-3.1 Weather limitations. The prime coat shall be applied only when the existing surface is dry; the atmospheric temperature is 50°F (10°C) or above, and the temperature has not been below 35°F (2°C) for the 12 hours prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the Engineer.

602-3.2 Equipment. The equipment shall include a self-powered pressure bituminous material distributor and equipment for heating bituminous material.

Provide a distributor with pneumatic tires of such size and number that the load produced on the base surface does not exceed 65.0 psi (4.5 kg/sq cm) of tire width to prevent rutting, shoving or otherwise damaging the base, surface or other layers in the pavement structure. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard (0.23 to 9.05 L/square meter), with a pressure range of 25 to 75 psi (172.4 to 517.1 kPa) and with an allowable variation from the specified rate of not more than ±5%, and at variable widths. Include with the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. Equip the distributor to circulate and agitate the bituminous material during the heating process. If the distributor is not equipped with an operable quick shutoff valve, the prime operations shall be started and stopped on building paper. The Contractor shall remove blotting sand prior to asphalt concrete lay down operations at no additional expense to the Owner.

A power broom and power blower suitable for cleaning the surfaces to which the bituminous coat is to be applied shall be provided.

602-3.3 Application of bituminous material. Immediately before applying the prime coat, the full width of the surface to be primed shall be swept with a power broom to remove all loose dirt and other objectionable material.

The bituminous material shall be uniformly applied with a bituminous distributor at the rate of 0.15 to 0.30 gallons per square yard (0.68 to 1.36 liters per square meter) depending on the base course surface texture. The type of bituminous material and application rate shall be approved by the Engineer prior to application.

Following application of the bituminous material and prior to application of the succeeding layer of pavement, allow the bituminous coat to cure and to obtain evaporation of any volatiles or moisture. Maintain the coated surface until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas. Allow the prime coat to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course. Furnish and spread enough sand to effectively blot up and cure excess bituminous material. Keep traffic off surfaces freshly treated with bituminous material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces.

602-3.4 Trial applications. Before providing the complete bituminous coat, the Contractor shall apply three lengths of at least 100 feet (30 m) for the full width of the distributor bar to evaluate the amount of bituminous material that can be satisfactorily applied with the equipment. Apply three different trial application rates of bituminous materials within the application range specified in paragraph 602-3.3. Other trial applications will be made using various amounts of material as deemed necessary by the Engineer.

602-3.5 Bituminous material Contractor's responsibility. The Contractor shall provide a statement of source and character of the proposed bituminous material which must be submitted to and approved by the Engineer before any shipment of bituminous materials to the project. The Contractor shall furnish vendor's certified test reports for each carload, or equivalent, of bituminous material shipped to the project. The test reports shall be provided to and approved by the Engineer before the bituminous material is applied. If the bituminous material

does not meet the specifications, it shall be replaced at the Contractor's expense. The engineer may use the local state DOT agency supplier certification program for approval instead of the test reports. Furnishing the vendor's certified test report for the bituminous material shall not be interpreted as basis for final acceptance. Samples may be taken and tested for verification by the engineer when material is delivered to the site.

602-3.6 Freight and weigh bills. The Contractor shall submit waybills and delivery tickets during the progress of the work. Before the final estimate is allowed, file with the Engineer certified waybills and certified delivery tickets for all bituminous materials used in the construction of the pavement covered by the contract. Do not remove bituminous material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

METHOD OF MEASUREMENT

602-4.1 The bituminous material for prime coat shall be measured by the gallon. Volume shall be corrected to the volume at 60°F (16°C) in accordance with ASTM D1250. The bituminous material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 10% over the specified application rate. Any amount of bituminous material more than 10% over the specified application rate for each application will be deducted from the measured quantities, except for irregular areas where hand spraying of the bituminous material is necessary. Water added to emulsified asphalt will not be measured for payment.

BASIS OF PAYMENT

602-5.1 Payment shall be made at the contract unit price per gallon for bituminous prime coat. This price shall be full compensation for furnishing all materials and for all preparation, delivering, and applying the materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item A21	Bituminous Prime Coat - per Gallon

TESTING REQUIREMENTS

ASTM D1250	Standard Guide for Use of the Petroleum Measurement Tables

MATERIAL REQUIREMENTS

ASTM D977	Standard Specification for Emulsified Asphalt
ASTM D2028	Standard Specification for Cutback Asphalt (Rapid-Curing Type)
ASTM D2397	Standard Specification for Cationic Emulsified Asphalt
ASTM D3628	Standard Practice for Selection and Use of Emulsified Asphalts

END OF ITEM P-602

Item P-603 Bituminous Tack Coat

PART 1: DESCRIPTION

1.1 This item shall consist of preparing and treating a bituminous or concrete surface with bituminous material in accordance with these specifications and in reasonably close conformity to the lines shown on the plans.

PART 2: MATERIALS

2.1 Bituminous materials. The bituminous material shall be an emulsified asphalt indicated in ASTM D3628 as a bituminous application for tack coat appropriate to local conditions or as designated by the Engineer.

PART 3: CONSTRUCTION METHODS

3.1 Weather limitations. The tack coat shall be applied only when the existing surface is dry and the atmospheric temperature is 50°F or above; the temperature has not been below 35°F for the 12 hours prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the Engineer.

3.2 Equipment. The Contractor shall provide equipment for heating and applying the bituminous material.

Provide a distributor with pneumatic tires of such size and number that the load produced on the base surface does not exceed 65.0 psi of tire width to prevent rutting, shoving or otherwise damaging the base, surface or other layers in the pavement structure. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, with a pressure range of 25 to 75 psi) and with an allowable variation from the specified rate of not more than ±5%, and at variable widths. Include with the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. Equip the distributor to circulate and agitate the bituminous material during the heating process. If the distributor is not equipped with an operable quick shutoff valve, the tack operations shall be started and stopped on building paper. The Contractor shall remove blotting sand prior to asphalt concrete lay down operations at no additional expense to the Owner.

A power broom and/or power blower suitable for cleaning the surfaces to which the bituminous tack coat is to be applied shall be provided.

3.3 Application of bituminous material. Immediately before applying the tack coat, the full width of surface to be treated shall be swept with a power broom and/or power blower to remove all loose dirt and other objectionable material.

Emulsified asphalt shall be diluted by the addition of water when directed by the Engineer and shall be applied a sufficient time in advance of the paver to ensure that all water has evaporated before the overlying mixture is placed on the tacked surface.

The bituminous material including vehicle shall be uniformly applied with a bituminous distributor at the rate of 0.05 to 0.10 gallons per square yard depending on the condition of the existing surface. The type of bituminous material and application rate shall be approved by the Engineer prior to application.

After application of the tack coat, the surface shall be allowed to cure without being disturbed for the period of time necessary to permit drying and setting of the tack coat. This period shall be determined by the Engineer. The Contractor shall protect the tack coat and maintain the surface until the next course has been placed.

3.4 Bituminous material Contractor's responsibility. The Contractor shall provide a statement of source and character of the proposed bituminous material which must be submitted and approved by the Engineer before any shipment of bituminous materials to the project.

The Contractor shall furnish the vendor's certified test reports for each carload, or equivalent, of bituminous material shipped to the project. The tests reports shall be provided to and approved by the Engineer before the bituminous material is applied. If the bituminous material does not meet the specifications, it shall be replaced at the Contractor's expense. Furnishing the vendor's certified test report for the bituminous material shall not be interpreted as a basis for final acceptance.

3.5 Freight and weigh bills The Contractor shall submit waybills and delivery tickets, during progress of the work. Before the final statement is allowed, file with the Engineer certified waybills and certified delivery tickets for all bituminous materials used in the construction of the pavement covered by the contract. Do not remove bituminous material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

PART 4: METHOD OF MEASUREMENT

4.1 The bituminous material for tack coat shall be measured by the gallon Volume shall be corrected to the volume at 60°F (16°C) in accordance with ASTM D1250. The bituminous material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 10% over the specified application rate. Any amount of bituminous material more than 10% over the specified application rate for each application will be deducted from the measured quantities, except for irregular areas where hand spraying of the bituminous material is necessary. Water added to emulsified asphalt will not be measured for payment.

PART 5: BASIS OF PAYMENT

5-1 Payment shall be made at the contract unit price per gallon of bituminous material. This price shall be full compensation for furnishing all materials, for all preparation, delivery, and application of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item A22	Bituminous Tack Coat - per gallon

MATERIAL REQUIREMENTS

ASTM D633	Standard Volume Correction Table for Road Tar
ASTM D977	Standard Specification for Emulsified Asphalt
ASTM D1250	Standard Guide for Use of the Petroleum Measurement Tables
ASTM D2028	Standard Specification for Cutback Asphalt (Rapid-Curing Type)
ASTM D2397	Standard Specification for Cationic Emulsified Asphalt
ASTM D3628	Standard Practice for Selection and Use of Emulsified Asphalts

END ITEM P-603

Item P-608 Emulsified Asphalt Seal Coat

PART 1: DESCRIPTION[1]

1.1 This item shall consist of the application of a emulsified asphalt surface treatment composed of an emulsion of natural and refined asphalt materials, water and, if specified, a polymer additive, for taxiways and runways with the application of a suitable aggregate to maintain adequate surface friction; and airfield secondary and tertiary pavements including low-speed taxiways, shoulders, overruns, roads, parking areas, and other general applications with or without aggregate applied. Emulsified Asphalt Seal Coat products assist in pavement preservation through reducing the rate of pavement oxidation. The emulsified asphalt surface treatment shall be applied in accordance with these specifications, and as shown on the plans or as directed by the Engineer.

[1] The terms seal coat and sealer binder and asphalt material are interchangeable throughout this specification. The term emulsified asphalt means an emulsion of natural and refined asphalt materials.

1.2 Quantities of materials per square yard . The approximate amounts of materials per square yard for the asphalt surface treatment shall be as provided in the table for the treatment area(s) at the specified dilution rate(s) as noted on the plans. The actual application rates will vary within the range specified to suit field conditions and will be recommended by the manufacturer's representative and approved by the Engineer from the test area/sections evaluation.

Application Rate

Dilution Rate	Quantity of Emulsion gal/yd^2 (l/m^2)	Quantity of Aggregate lb/yd^2 (kg/m^2)
1:1	0.10-0.15 (0.45-0.68)	0.20-0.50 (0.11-0.27)

PART 2: MATERIALS

2.1 Aggregate. The aggregate material shall be a dry, clean, dust and dirt free, sound, durable, angular shaped manufactured specialty sand, such as that used as an abrasive, with a Mohs hardness of 6 to 8. The Contractor shall submit manufacturer's technical data and a manufacturer's certification indicating that the specialty sand meets the requirements of the specification to the Engineer prior to start of construction. The sand must be approved for use by the Engineer and shall meet the following gradation limits when tested in accordance with ASTM C136 and ASTM C117:

Aggregate Material Gradation Requirements

Sieve Designation (square openings)	Percentage by Weight Retained Sieves
No. 8 (2.38 mm)	0
No. 16 (1.19 mm)	0-8
No. 20 (0.84 mm)	0-28
No. 30 (0.60 mm)	20-50
No. 40 (0.42 mm)	10-55
No. 50 (0.30 mm)	0-30
No. 70 (0.21 mm)	0-5
No. 100 (0.15 mm)	0-2
No. 200 (0.07 mm)	0-2

The Contractor shall provide a certification showing particle size analysis and properties of the material delivered for use on the project. The Contractor's certification may be subject to verification by testing the material delivered for use on the project.

2.2 Asphalt material. The Contractor shall furnish the vendor's certified test reports for the emulsified asphalt, in its concentrated form, to the Engineer, showing that the material meets the following properties:

Concentrated Asphalt Material Properties

Properties	Specification	Limits
Saybolt Furol Viscosity at 77°F (25°C)	ASTM D244	20 – 100 seconds
Residue by Distillation or Evaporation	ASTM D244	57% minimum
Sieve Test	ASTM D244	0.1% maximum
24-hour Stability	ASTM D244	1% maximum
5-day Settlement Test	ASTM D244	5.0% maximum
Particle Charge [1]	ASTM D244	Positive 6.5 maximum pH

[1] pH may be used in lieu of the particle charge test which is sometimes inconclusive in slow setting, asphalt emulsions.

The asphalt material concentrate must be diluted with heated water prior to application. The asphalt material, when diluted in the volumetric proportion of one part concentrated asphalt material to one part hot water shall have the following properties:

One-to-One Dilution Emulsion Properties

Properties	Specification	Limits
In Ready-to-Apply Form, one part concentrate to one part water, by volume		
Saybolt Furol Viscosity at 77°F (25°C)	ASTM D244	10 – 50 seconds
Residue by Distillation or Evaporation	ASTM D244	28.5% minimum
Pumping Stability [1]		Pass

[1] Pumping stability is tested by pumping one pint (475 ml) of seal coat diluted one (1) part concentrate to one (1) part water, at 77°F (25°C), through a 1/4-inch (6 mm) gear pump operating 1750 rpm for 10 minutes with no significant separation or coagulation.

Two-to-One Dilution Emulsion Properties

Properties	Specification	Limits
In Ready-to-Apply Form, two parts concentrate to one part water, byolume		
Saybolt Furol Viscosity at 77°F (25°C)	ASTM D244	10 – 50 seconds
Residue by Distillation or Evaporation	ASTM D244	38% minimum
Pumping Stability [1]		Pass

[1] Pumping stability is tested by pumping one pint (475 ml) of seal coat diluted one (1) part concentrate to one (1) part water, at 77°F (25°C), through a 1/4-inch (6 mm) gear pump operating 1750 rpm for 10 minutes with no significant separation or coagulation.

The asphalt material base residue shall contain not less than 20% gilsonite, or uintaite and shall not contain any tall oil pitch or coal tar material. The material shall be compatible with asphaltic concrete, and have a 5-year minimum proven performance record at airports with similar climatic conditions. Curing time, under recommended application conditions, shall not exceed eight (8) hours.

Emulsion Residue by Distillation or Evaporation Tests

Properties	Specification	Limits
Viscosity at 275°F (135°C)	ASTM D4402	1750 cts maximum
Solubility in 1, 1, 1 trichloroethylene	ASTM D2042	97.5% minimum
Penetration	ASTM D5	50 dmm maximum
Asphaltenes	ASTM D2007	15% minimum
Saturates	ASTM D2007	15% maximum
Polar Compounds	ASTM D2007	25% minimum
Aromatics	ASTM D2007	15% minimum

The Contractor shall furnish vendor's certified test reports showing that the material is the type, grade and quality specified for each load of asphalt material delivered to the project. The certification shall also show the shipment number, refinery, consignee, destination, contract number and date of shipment. The test reports and certification shall be delivered to the Engineer before permission is granted to use the material. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's material test report certification may be subject to verification by testing the material delivered for use on the project.

The asphalt material storage and handling temperature shall be between 50°F - 160°F (10°C - 70°C) and the material shall be protected from freezing, or whenever outside temperature drops below 40°F (4°C) for prolonged time periods.

2.3 Water. Water used in making the emulsion shall be potable, free from harmful soluble salts and chemicals, and at least 100°F (38°C).

2.4 Polymer. The polymer shall be a vinyl acrylic polymer approved for use by the asphalt material manufacturer. The Contractor shall submit manufacturer's technical data, the manufacturer's certification indicating that the polymer meets the requirements of the specification, and the asphalt material manufacturer's approval of its use to the Engineer. The polymer must be approved for use by the Engineer and shall meet the following properties:

Polymer Properties

Properties	Limits
Solids Content	54 to 57%, Percent by Weight
Weight	8.9 to 9.8 pounds/gallon (1.07 to 1.17 kg/L)
pH	4.0 to 6.0
Particle Charge	Nonionic/Anionic
Mechanical Stability	Excellent
Film Forming Temperature, °C	+5°C, minimum
Tg,°C	22°C, maximum

PART 3: APPLICATION RATE

3.1 Material performance for runway and high-speed taxiway projects. The Contractor shall submit to the Engineer friction tests, from previous airport projects which used the seal coat materials in a similar environment, in accordance with AC 150/5320-12, at 40 or 60 mph (65 or 95 km/h) wet, showing, as a minimum; friction value of pavement surface prior to sealant application; two values, tested between 24 and 96 hours after application, with a minimum of 24 hours between tests; and one value tested at no less than 180 days or greater than 360 days after the application. The results of the two tests between 24 and 96 hours shall indicate friction is increasing at a rate to obtain similar friction value of the pavement surface prior to application, and the long term test shall indicate no apparent adverse effect with time relative to friction values and existing pavement surface. The Contractor shall submit to the Engineer a list of airports which meet the above requirements, as well as technical details on application rates, aggregate rates, and point of contact at these airports to confirm use and success of sealer with aggregate. Friction tests shall be submitted from no less than one of the airports on the list and each set of tests described above, must be from one project.

Seal coat material submittal without required friction performance will not be approved. Friction tests performed on this project cannot be used as a substitute of this requirement.

3.2 Test areas and test sections. A qualified manufacturer's representative shall be present in the field to assist the Contractor in applying test areas and/or test sections to determine the appropriate application rate of both emulsion and sand to be approved by the Engineer.

A test area and/or section shall be applied for each differing HMA pavement surface identified in the project. The test area(s) and/or test section(s) shall be used to determine the material application rate(s) of both emulsion and sand prior to full production. The same equipment and method of operation shall be utilized on the test area(s) and/or test section(s) as will be utilized on the remainder of the work.

a. For taxiway, taxilane and apron surfaces. Prior to full application, the Contractor shall place test areas at varying application rates as advised by the manufacturer's representative and acceptable to the Engineer to determine appropriate application rate(s). The test areas will be located on representative section(s) of the pavement to receive the asphalt surface treatment designated by the Engineer.

b. For runway and high speed exit taxiway surfaces. Not applicable.

PART 4: CONSTRUCTION METHODS

4.1 Worker safety. The seal coat product shall be handled with caution. The Contractor shall obtain a Material Safety Data Sheet (MSDS) for both the asphalt emulsion product and sand and require workmen to follow the manufacturer's recommended safety precautions.

4.2 Weather limitations. The asphalt emulsion shall be applied only when the existing pavement surface is dry and when the weather is not foggy, rainy, or when the wind velocity will prevent the uniform application of the material. No material shall be applied when dust or sand is blowing or when rain is anticipated within eight (8) hours of application completion. The atmospheric temperature and the pavement surface temperature shall both be above 60°F (16°C) and rising. During application, account for wind drift. Cover existing buildings, structures, runway edge lights, taxiway edge lights, informational signs, retro-reflective marking and in-pavement duct markers as necessary to protect against overspray before applying the emulsion. Should emulsion get on any light or marker fixture, promptly clean the fixture. If cleaning is not satisfactory to the Engineer, the Contractor shall replace any light, sign or marker with equivalent equipment at no cost to the Owner.

4.3 Equipment and tools. The Contractor shall furnish all equipment, tools, and machinery necessary for the performance of the work.

a. Pressure distributor. The emulsion shall be applied with a manufacturer-approved computer rate-controlled asphalt distributor. The equipment shall be in good working order and contain no contaminants or diluents in the tank. Spreader bar tips must be clean, free of burrs, and of a size to maintain an even distribution of the emulsion. Any type of tip or pressure source is suitable that will maintain predetermined flow rates and constant pressure during the application process with application speeds under eight (8) miles per hour (13 km per hour) or seven (700) feet per minute (213 m per minute). Test the equipment under pressure for leaks and to ensure it is in good working order before use.

The distributor truck shall be equipped with a 12-foot (3.7-m), minimum, spreader bar with individual nozzle control. The distributor truck shall be capable of specific application rates in the range of 0.05 to 0.25 gallons per square yard (0.15 to 0.80 liters per square meter). These rates shall be computer-controlled rather than mechanical. The distributor truck shall have an easily accessible thermometer that constantly monitors the temperature of the emulsion, and have an operable mechanical tank gauge that can be used to cross-check the computer accuracy.

A distributor truck shall be provided, if necessary, equipped to effectively heat and mix the material to the required temperature prior to application. Heating and mixing shall be done in accordance with the manufacturer's recommendations. Care shall be taken not to overheat or over mix the material.

The distributor shall be equipped to hand spray the emulsion in areas identified either on the plans or by the Engineer.

b. Aggregate spreader. The asphalt distributor truck will be equipped with an aggregate spreader mounted to the distributer truck that can apply sand to the emulsion in a single pass operation without driving through wet emulsion. The aggregate spreader shall be equipped with a variable control system capable of uniformly distributing the sand at the specified rate at varying application widths and speeds. The sander shall have a minimum hopper capacity of at least 3,000 pounds (1361 kg) of sand. Push-type hand sanders will be allowed for use around lights, signs and other obstructions.

c. Power broom/blower. A power broom and/or blower shall be provided for removing loose material from the surface to be treated.

d. Equipment calibration. The Contractor shall calibrate the equipment using either of the following procedures:

(1) First procedure. The Contractor shall furnish a State Calibration Certification for the emulsified asphalt distributor, from any state providing that service, or other acceptable agency certification approved by the Engineer, and the calibration date shall have been within six (6) months of the contract award, or up to 12 months if supporting documents substantiate continuous work using the same distributor.

(2) Second procedure. The Contractor shall furnish all equipment, materials and labor necessary to calibrate the emulsified asphalt distributor and the aggregate spreader. Perform all calibrations with the approved job materials and prior to applying the specified coatings to the prepared surface. Perform calibration of the emulsified asphalt distributor in accordance with ASTM D2995.

Perform work to calibrate the tank and measuring devices of the distributor. Perform inspection and calibration at the beginning of the work and at least once a day during construction.

4.4 Preparation of asphalt pavement surfaces. Clean pavement surface immediately prior to placing the seal coat by sweeping, flushing well with water leaving no standing water, or a combination of both, so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film. Remove oil or grease that has not penetrated the asphalt pavement by scraping or by scrubbing with a detergent, then wash thoroughly with clean water. After cleaning, treat these areas with the oil spot primer. Any additional surface preparation, such as crack repair, shall be in accordance with paragraph 101-3.6.

a. New asphalt pavement surfaces. Allow new asphalt pavement surfaces to cure so that there is no concentration of oils on the surface. A period of at least 30 days at 70°F (21°C) daytime temperatures shall elapse between the placement of a hot mixed asphalt concrete surface course and the application of the surface treatment.

Perform a water-break-free test to confirm that the surface oils have degraded and dissipated. (Cast approximately one gallon (4 liters) of clean water out over the surface. The water should sheet out and wet the surface uniformly without crawling or showing oil rings.) If signs of crawling or oil rings are apparent on the pavement surface, additional time must be allowed for additional curing and retesting of the pavement surface prior to treatment.

4.5 Emulsion mixing. The application emulsion shall be obtained by blending asphalt material concentrate, water and polymer, if specified. Always add heated water to the asphalt material concentrate, never add asphalt material concentrate to heated water. Mix one part heated water to one partasphalt material concentrate, by volume.

If polymer is required, add 1% polymer, by volume, to the emulsion mix. If the polymer is added to the emulsion mix at the plant, submit weigh scale tickets to the Engineer. As an option, the polymer may be added to the emulsion mix at the job site provided the polymer is added slowly while the circulating pump is running. The mix must be agitated for a minimum of 15 minutes or until the polymer is mixed to the satisfaction of the Engineer.

4.6 Application of asphalt emulsion. The asphalt emulsion shall be applied using a pressure distributor upon the properly prepared, clean and dry surface at the application rate recommended by the manufacturer's representative and approved by the Engineer from the test area/sections evaluation for each designated treatment area. The asphalt emulsion should be applied at a temperature between 130°F (54°C) and 160°F (70°C) or in accordance with the manufacturer's recommendation.

Pavement surfaces which have excessive runoff of seal coat due to excessive amount of material being applied or excessive surface grade shall be treated in two or more applications to the specified application rate at no additional cost to the Owner. Each additional application shall be performed after the prior application of material has penetrated into the pavement.

If low spots and depressions greater than 1/2 inch in depth in the pavement surface cause ponding or puddling of the applied materials, the pavement surface shall be broomed with a broom drag. Brooming shall continue until the pavement surface is free of any pools of excess material. Ponding and/or puddling shall not cause excessive pavement softening and/or additional distress. The Engineer shall inspect and approve areas after brooming.

During all applications, the surfaces of adjacent structures shall be protected to prevent their being spattered or marred. Asphalt materials shall not be discharged into borrow pits or gutters or on the airport area.

4.7 Application of aggregate material. Immediately following the application of the asphalt emulsion or as directed by the Engineer, sand at the rate recommended by the manufacturer's representative and approved by the Engineer from the test area/sections evaluation for each designated application area, shall be spread uniformly over the asphalt emulsion. The aggregate shall be spread to the same width of application as the asphalt material and shall not be applied in such thickness as to cause blanketing.

Sprinkling of additional aggregate material, and spraying additional asphalt material over areas that show up having insufficient cover or bitumen, shall be done by hand whenever necessary. In areas where hand work is necessitated, the sand shall be applied before the sealant begins to break.

Sanding shall be performed to prevent excessive amounts of sand from accumulating on the pavement prior to the emulsion being applied. The Contractor shall clean areas with excess or loose sand and dispose of off airport property.

PART 5: QUALITY CONTROL

5.1 Manufacturer's representation. The manufacturer's representative shall have knowledge of the material, procedures, and equipment described in the specification and shall be responsible for determining the application rates and shall oversee the preparation and application of the seal coat product. Documentation of the manufacturer representative's experience and knowledge for applying the seal coat product shall be furnished to the Engineer a minimum of 10 work days prior to placement of the test sections. The cost of the manufacturer's representative shall be included in the bid price.

5.2 Contractor qualifications. The Contractor shall provide the Engineer Contractor qualifications for applicators, personnel and equipment. The Contractor shall also provide documentation that the Contractor is qualified to apply the seal coat and to have made at least three (3) applications similar to this project in the past two (2) years.

PART 6: MATERIAL ACCEPTANCE

6.1 Friction tests. Not required.

PART 7: METHOD OF MEASUREMENT

7.1 Asphalt surface treatment. The quantity of asphalt surface treatment shall be measured by the square yards of material applied in accordance with the plans and specifications and accepted by the Engineer.

The Contractor must furnish the Engineer with the certified weigh bills when materials are received for the asphalt material used under this contract. The Contractor must not remove material from the tank car or storage tank until initial amounts and temperature measurements have been verified.

PART 8: BASIS OF PAYMENT

8.1 Payment shall be made at the contract unit price per square yard for the asphalt surface treatment applied and accepted by the Engineer, and the contract unit price per lump sum for runway friction testing. This price shall be full compensation for all surface preparation, furnishing all materials, delivery and application of these materials, for all labor, equipment, tools, and incidentals necessary to complete the item, including the friction testing and all work required to meet AC 150/5320-12, and any costs associated with furnishing a qualified manufacturer's representative to assist with test strips.

Payment will be made under:

Item A23 Asphalt Surface Treatment – per square yard

TESTING REQUIREMENTS

ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM D5	Standard Test Method for Penetration of Bituminous Materials
ASTM D244	Standard Test Methods and Practices for Emulsified Asphalts
ASTM D2007	Standard Test Method for Characteristic Groups in Rubber Extender and Processing Oils and Other Petroleum-Derived Oils by the Clay-Gel Absorption Chromatographic Method
ASTM D2042	Standard Test Method for Solubility of Asphalt Materials in Trichloroethylene
ASTM D2995	Standard Practice for Estimating Application Rate of Bituminous Distributors
ASTM D4402	Standard Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
ASTM D5340	Standard Test Method for Airport Pavement Condition Index Surveys
AC 150/5320-12	Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces
AC 150/5320-17	Airfield Pavement Surface Evaluation and Rating (PASER) Manuals
AC 150/5380-6	Guidelines and Procedures for Maintenance of Airport Pavements

END OF ITEM P-608

Item P-620 Runway and Taxiway Marking

PART 1: DESCRIPTION

1.1 This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Engineer. The terms “paint” and “marking material” as well as “painting” and “application of markings” are interchangeable throughout this specification.

PART 2: MATERIALS

2.1 Materials acceptance. The Contractor shall furnish manufacturer’s certified test reports for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. The reports can be used for material acceptance or the Engineer may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the Engineer upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers 55 gallons or smaller for inspection by the Engineer. Material shall not be loaded into the equipment until inspected by the Engineer.

2.2 Marking materials. Paint shall be **waterborne**, in accordance with the requirements of paragraph 620-2.2. Paint shall be furnished in **White-37925 and Yellow-33538 or 33655** in accordance with Federal Standard No. 595.

a. Waterborne. Paint shall meet the requirements of Federal Specification TT-P-1952E, **Type II**.

2.3 Reflective media. Glass beads shall meet the requirements for **Federal Specification TT-B-1325D, Type III**. Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.

PART 3: CONSTRUCTION METHODS

3.1 Weather limitations. The painting shall be performed only when the surface is dry and when the surface temperature is at least 45°F (7°C) and rising and the pavement surface temperature is at least 5°F (2.7°C) above the dew point or meets the manufacturer’s recommendations. Markings shall not be applied when the pavement temperature is greater than 130°F (55°C). Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns.

3.2 Equipment. Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type or airless-type marking machine suitable for application of traffic paint. It shall produce an even and uniform film thickness at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray.

3.3 Preparation of surface. Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other foreign material that would reduce the bond between the paint and the pavement. The area to be painted shall be cleaned by sweeping, blowing,**or by other**methods as required to remove all contaminants minimizing damage to the pavement surface. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the Engineer. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

Paint shall not be applied to Portland cement concrete pavement until the areas to be painted are clean of curing material. Sandblasting or high-pressure water shall be used to remove curing materials.

At least 24 hours prior to remarking existing markings, loose existing markings must be removed such that 100% of the loose existing markings are removed. After removal, the surface shall be cleaned of all residue or debris either with sweeping or blowing with compressed air or both prior to the application of any markings, the Contractor shall certify in writing that the surface has been prepared in accordance with the paint manufacturer's requirements, that the application equipment is appropriate for the type of marking paint and that environmental conditions are appropriate for the material being applied. This certification along with a copy of the paint manufacturer's surface preparation and application requirements must be submitted and approved by the Engineer prior to the initial application of markings.

3.4 Layout of markings. The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be shown on the plans.

3.5 Application. Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the Engineer. The edges of the markings shall not vary from a straight line more than 1/2 inch (12 mm) in 50 feet (15 m), and marking dimensions and spacings shall be within the following tolerances:

Dimension and Spacing	Tolerance
36 inch (910 mm) or less	±1/2 inch (12 mm)
greater than 36 inch to 6 feet (910 mm to 1.85 m)	±1 inch (25 mm)
greater than 6 feet to 60 feet (1.85 m to 18.3 m)	±2 inch (50 mm)
greater than 60 feet (18.3 m)	±3 inch (76 mm)

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate shown in Table 1. The addition of thinner will not be permitted. A period of **30 days** shall elapse between placement of a bituminous surface course or seal coat and full application of the paint. Initial markings will be applied at **25%** application rate with no beads, as indicated on the plans, immediately after paving operations are completed. After the full curing period of 30 days from the date of completion of initial markings, a full application with glass beads shall be applied to the pavement.

Prior to the initial application of markings, the Contractor shall certify in writing that the surface has been prepared in accordance with the paint manufacturer's requirements, that the application equipment is appropriate for the marking paint and that environmental conditions are appropriate for the material being applied. This certification along with a copy of the paint manufactures application and surface preparation requirements must be submitted to the Engineer prior to the initial application of markings.

3.6 Test strip. Prior to the full application of airfield markings, the Contractor shall produce a test strip in the presence of the Engineer. The test strip shall include the application of a minimum of 5 gallons (4 liters) of paint and application of 35 lbs (15.9 kg) of Type I/50 lbs (22.7 kg) of Type III glass beads. The test strip shall be used to establish thickness/darkness standard for all markings. The test strip shall cover no more than the maximum area prescribed in Table 1 (e.g., for 5 gallons (19 liters) of waterborne paint shall cover no more than 575 square feet (53.4 m^2).

Table 1. Application Rates For Paint And Glass Beads
(See Note regarding Red and Pink Paint)

Paint Type	Paint Square feet per gallon, ft^2/gal (Sq m per liter, m^2/l)	Glass Beads, Type I, Gradation A Pounds per gallon of paint-lb/gal (Km per liter of paint-kg/l)	Glass Beads, Type III Pounds per gallon of paint-lb/gal (Km per liter of paint-kg/l)	Glass Beads, Type IV Pounds per gallon of paint-lb/gal (Km per liter of paint-kg/l)
Waterborne Type II	115 ft2/gal max (2.8 m2/l)	7 lb/gal min (0.85 kg/l)	10 lb/gal min (1.2 kg/l)	--

Glass beads shall be distributed upon the marked areas at the locations shown on the plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 1. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment should be performed.

All emptied containers shall be returned to the paint storage area for checking by the Engineer. The containers shall not be removed from the airport or destroyed until authorized by the Engineer.

3.7 Application--preformed thermoplastic airport pavement markings.

a. Asphalt and Portland cement. To ensure minimum single-pass application time and optimum bond in the marking/substrate interface, the materials must be applied using a variable speed self-propelled mobile heater with an effective heating width of no less than 16 feet (5 m) and a free span between supporting wheels of no less than 18 feet (5.5 m). The heater must emit thermal radiation to the marking material in such a manner that the difference in temperature of 2 inches (50 mm) wide linear segments in the direction of heater travel must be within 5% of the overall average temperature of the heated thermoplastic material as it exits the heater. The material must be able to be applied at ambient and pavement temperatures down to 35°F (2°C) without any preheating of the pavement to a specific temperature. The material must be able to be applied without the use of a thermometer. The pavement shall be clean, dry, and free of debris. A non-volatile organic content (non-VOC) sealer with a maximum applied viscosity of 250 centiPoise must be applied to the pavement shortly before the markings are applied. The supplier must enclose application instructions with each box/package.

3.8 Protection and cleanup. After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings. The Contractor shall remove from the work area all debris, waste, loose or unadhered reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the Engineer. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and Federal environmental statutes and regulations.

PART 4: METHOD OF MEASUREMENT

620-4.1 The quantity of runway and taxiway markings including aprons to be paid for shall be the number of square feet (square meters) of painting with the required application of glass beads performed in accordance with the specifications and accepted by the Engineer. Application of glass beads shall be considered incidental to the painting item. A 25% application on pavement surfaces will be measured as 25% square footage. The remaining 75% square footage will be measured upon the full application with glass beads on the airport pavement.

PART 5: BASIS OF PAYMENT

5.1 Payment shall be made at the respective contract price per square foot for runway, taxiway, and apron painting. Including reflective media. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item. A 25% application will be paid at 25% of square footage and after the final application, the remaining 75% payment will be made.

This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item A24	Pavement Marking – per square foot

TESTING REQUIREMENTS

ASTM C371	Standard Test Method for Wire-Cloth Sieve Analysis of Nonplastic Ceramic Powders
ASTM D92	Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D711	Standard Test Method for No-Pick-Up Time of Traffic Paint
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1652	Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D2074	Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D7585	Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments
ASTM E1710	Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
ASTM E2302	Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

MATERIAL REQUIREMENTS

ASTM D476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
40 CFR Part 60, Appendix A-7, Method 24	Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings
29 CFR Part 1910.1200	Hazard Communication
FED SPEC TT-B-1325D	Beads (Glass Spheres) Retro-Reflective
American Association of State Highway and Transportation Officials (AASHTO) M247	Standard Specification for Glass Beads Used in Pavement Markings
FED SPEC TT-P-1952E	Paint, Traffic and Airfield Marking, Waterborne
Commercial Item Description	

A-A-2886B	Paint, Traffic, Solvent Based
FED STD 595	Colors used in Government Procurement
AC 150/5340-1	Standards for Airport Markings

END OF ITEM P-620

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Item D-701 Pipe for Storm Drains and Culverts

PART 1: DESCRIPTION

1.1 This item shall consist of the construction of pipe culverts and storm drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans.

PART 2: MATERIALS

2.1 Materials shall meet the requirements shown on the plans and specified below.

2.2 Pipe. The pipe shall be of the type called for on the plans or in the proposal and shall be in accordance with the following appropriate requirements:

AASHTO M252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM F667	Standard Specification for 3 through 24 in Corrugated Polyethylene Pipe and Fittings
ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

2.3 Concrete. Concrete for pipe cradles shall have a minimum compressive strength of 2000 psi at 28 days and conform to the requirements of ASTM C94.

2.4 Rubber gaskets. Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C443. Rubber gaskets for PVC pipe, polyethylene, and polypropylene pipe shall conform to the requirements of ASTM F477. Rubber gaskets for zinc-coated steel pipe and precoated galvanized pipe shall conform to the requirements of ASTM D1056, for the “RE” closed cell grades. Rubber gaskets for steel reinforced thermoplastic ribbed pipe shall conform to the requirements of ASTM F477.

2.5 Joint mortar. Pipe joint mortar shall consist of one part Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.

2.6 Joint fillers. Poured filler for joints shall conform to the requirements of ASTM D6690.

2.7 Plastic gaskets. Plastic gaskets shall conform to the requirements of AASHTO M198 (Type B).

2.8. Controlled low-strength material (CLSM). CLSM is not allowed.

PART 3: CONSTRUCTION METHODS

3.1 Excavation. The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but it shall not be less than the external diameter of the pipe plus 6 inches (150 mm) on each side. The trench walls shall be approximately vertical.

The Contractor shall comply with all current Federal, state and local rules and regulations governing the safety of men and materials during the excavation, installation and backfilling operations. Specifically, the Contractor shall observe that all requirements of the Occupational Safety and Health Administration (OSHA) relating to excavations, trenching and shoring are strictly adhered to. The width of the trench shall be sufficient to permit satisfactorily jointing of the pipe and thorough compaction of the bedding material under the pipe and backfill material around the pipe, but it shall not be greater than the widths

shown on the plans trench detail. The trench bottom shall be shaped to fully and uniformly support the bottom quadrant of the pipe.

Where rock, hardpan, or other unyielding material is encountered, the Contractor shall remove it from below the foundation grade for a depth of at least 8 inch or 1/2 inch for each foot of fill over the top of the pipe (whichever is greater) but for no more than three-quarters of the nominal diameter of the pipe. The excavation below grade shall be backfilled with selected fine compressible material, such as silty clay or loam, and lightly compacted in layers not over 6 inches in uncompacted depth to form a uniform but yielding foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The Engineer shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

The excavation for pipes placed in embankment fill shall not be made until the embankment has been completed to a height above the top of the pipe as shown on the plans.

3.2 Bedding. The pipe bedding shall conform to the class specified on the plans. The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. When no bedding class is specified or detailed on the plans, the requirements for Class C bedding shall apply.

a. Rigid pipe. Class A bedding shall consist of a continuous concrete cradle conforming to the plan details.

Class B bedding shall consist of a bed of granular material having a thickness of at least 6 inches below the bottom of the pipe and extending up around the pipe for a depth of not less than 30% of the pipe's vertical outside diameter. The layer of bedding material shall be shaped to fit the pipe for at least 10% of the pipe's vertical diameter and shall have recesses shaped to receive the bell of bell and spigot pipe. The bedding material shall be sand or select sandy soil with 100% passing a 3/8 inch sieve and not more than 10% passing a No. 200 sieve.

Class C bedding shall consist of bedding the pipe in its natural foundation material to a depth of not less than 10% of the pipe's vertical outside diameter. The bed shall be shaped to fit the pipe and shall have recesses shaped to receive the bell of bell and spigot pipe.

b. Flexible pipe. For flexible pipe, the bed shall be roughly shaped to fit the pipe, and a bedding blanket of sand or fine granular material shall be provided as follows:

Pipe Corrugation Depth		Minimum Bedding Depth	
inch	**mm**	**inch**	**mm**
1/2	12	1	25
1	25	2	50
2	50	3	75
2-1/2	60	3-1/2	90

c. PVC, polyethylene, and polypropylene pipe. For PVC, polyethylene, and polypropylene pipe, the bedding material shall consist of coarse sands and gravels with a maximum particle size of 3/4 inches. For pipes installed under paved areas, no more than 12% of the material shall pass the No. 200 sieve. For all other areas, no more than 50% of the material shall pass the No. 200 sieve. The bedding shall have a thickness of at least 6 inches below the bottom of the pipe and extend up around the pipe for a depth of not less than 50% of the pipe's vertical outside diameter.

3.3 Laying pipe. The pipe laying shall begin at the lowest point of the trench and proceed upgrade. The lower segment of the pipe shall be in contact with the bedding throughout its full length. Bell or groove ends of rigid pipes and outside circumferential laps of flexible pipes shall be placed facing upgrade.

Paved or partially lined pipe shall be placed so that the longitudinal center line of the paved segment coincides with the flow line.

Elliptical and elliptically reinforced concrete pipes shall be placed with the manufacturer's reference lines designating the top of the pipe within five degrees of a vertical plane through the longitudinal axis of the pipe.

3.4 Joining pipe. Joints shall be made with (1) Portland cement mortar, (2) Portland cement grout, (3) rubber gaskets, (4) plastic gaskets, or (5) coupling bands.

Mortar joints shall be made with an excess of mortar to form a continuous bead around the outside of the pipe and shall be finished smooth on the inside. Molds or runners shall be used for grouted joints to retain the poured grout. Rubber ring gaskets shall be installed to form a flexible watertight seal.

a. Concrete pipe. Concrete pipe may be either bell and spigot or tongue and groove. The method of joining pipe sections shall be so the ends are fully entered and the inner surfaces are reasonably flush and even. Joints shall be thoroughly wetted before applying mortar or grout.

b. Metal pipe. Metal pipe shall be firmly joined by form-fitting bands conforming to the requirements of ASTM A760 for steel pipe and AASHTO M196 for aluminum pipe.

c. PVC, polyethylene and polypropylene pipe. Joints for PVC, Polyethylene, and Polypropylene pipe shall conform to the requirements of ASTM D3212 when water tight joints are required. Joints for PVC and Polyethylene pipe shall conform to the requirements of AASHTO M304 when soil tight joints are required. Fittings for polyethylene pipe shall conform to the requirements of AASHTO M252 or ASTM M294. Fittings for polypropylene pipe shall conform to ASTM F2881, ASTM F2736, or ASTM F2764.

3.5 Backfilling. Pipes shall be inspected before any backfill is placed; any pipes found to be out of alignment, unduly settled, or damaged shall be removed and relaid or replaced at the Contractor's expense.

Material for backfill shall be fine, readily compatible soil or granular material selected from the excavation or a source of the Contractor's choosing**.** It shall not contain frozen lumps, stones that would be retained on a 2-inch sieve, chunks of highly plastic clay, or other objectionable material. Granular backfill material shall have 95% or more passing the 1/2 inch sieve, with 95% or more being retained on the No. 4 sieve.

When the top of the pipe is even with or below the top of the trench, the backfill shall be compacted in layers not exceeding 6 inches on each side of the pipe and shall be brought up one foot above the top of the pipe or to natural ground level, whichever is greater. Thoroughly compact the backfill material under the haunches of the pipe without displacing the pipe. Material shall be brought up evenly on each side of the pipe for the full length of the pipe.

When the top of the pipe is above the top of the trench, the backfill shall be compacted in layers not exceeding 6 inches (and shall be brought up evenly on each side of the pipe to one foot above the top of the pipe. The width of backfill on each side of the pipe for the portion above the top of the trench shall be equal to twice the pipe's diameter or 12 feet, whichever is less.

For PVC, polyethylene, and polypropylene pipe, the backfill shall be placed in two stages; first to the top of the pipe and then at least 12 inches over the top of the pipe. The backfill material shall meet the requirements of paragraph 701-3.2c.

All backfill shall be compacted to the density required under Item P-152.

It shall be the Contractor's responsibility to protect installed pipes and culverts from damage due to construction equipment operations. The Contractor shall be responsible for installation of any extra strutting or backfill required to protect pipes from the construction equipment.

PART 4: METHOD OF MEASUREMENT

4.1 The length of pipe shall be measured in linear feet of pipe in place, completed, and approved. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face

of structure, whichever is applicable. The several classes, types and size shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipe being measured.

4.2 The volume of concrete for pipe cradles shall be the number of cubic yards of concrete that is completed in place and accepted.

4.3 The volume of rock shall be the number of cubic yards of rock excavated. No payment shall be made for the cushion material placed for the bed of the pipe.

PART 5: BASIS OF PAYMENT

5.1 Payment will be made at the contract unit price per linear foot for each kind of pipe of the type and size designated; at the contract unit price per cubic yard of concrete for pipe cradles; and at the contract unit price per cubic yard for rock excavation.

These prices shall fully compensate the Contractor for furnishing all materials and for all preparation, excavation, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item A25	8-inch Reinforced Concrete Pipe -	per linear foot

MATERIAL REQUIREMENTS

AASHTO M167	Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M190	Standard Specification for Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M196	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
AASHTO M198	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
AASHTO M219	Standard Specification for Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M243	Standard Specification for Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
AASHTO M252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
AASHTO M304	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
AASHTO MP20	Standard Specification for Steel Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 900-mm (12- to 36-in.) Diameter
ASTM A760	Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains
ASTM A761	Standard Specification for Corrugated Steel Structural Plate, Zinc Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
ASTM A762	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains

ASTM A849	Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM B745	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
ASTM C14	Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C94	Standard Specification for Ready Mixed Concrete
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C506	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C507	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
ASTM C655	Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
ASTM C1433	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
ASTM D1056	Standard Specification for Flexible Cellular Materials Sponge or Expanded Rubber
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F667	Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR PR) Based on Outside Diameter
ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe & Fittings Based on Controlled Inside Diameter
ASTM F894	Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
ASTM F2435	Standard Specification for Steel Reinforced Polyethylene (PE) Corrugated Pipe
ASTM F2562	Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage

ASTM F2736	Standard Specification for 6 to 30 in. (152 to 762 mm) Polypropylene (PP) Corrugated Single Wall Pipe and Double Wall Pipe
ASTM F2764	Standard Specification for 30 to 60 in. (750 to 1500 mm) Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
ASTM F2881	Standard Specification for 12 to 60 in. (300 to 1500 mm) Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications

END ITEM D-701

Item D-705 Pipe Underdrains for Airports

PART 1: DESCRIPTION

1.1 This item shall consist of the construction of pipe drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans.

PART 2: MATERIALS

2.1 General. Materials shall meet the requirements shown on the plans and specified below.

2.2 Pipe. The pipe shall be of the type called for on the plans or in the proposal and shall be in accordance with the following appropriate requirements.

AASHTO M252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M304	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
ASTM F758	Standard Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe & Fittings Based on Controlled Inside Diameter ASTM F949 Standard Specification for Poly (Vinyl Chloride)(PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

2.3 Joint mortar. Pipe joint mortar shall consist of one part by volume of Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.

2.4 Elastomeric seals. Elastomeric seals shall conform to the requirements of ASTM F477.

2.5 Porous backfill. Porous backfill shall be free of clay, humus, or other objectionable matter, and shall conform to the gradation in Table 1 when tested in accordance with ASTM C136.

Table 1. Gradation of Porous Backfill

Sieve Designation (square openings)	Percentage by Weight Passing Sieves
	Porous Material No. *
1-1/2 inch (38 mm)	
1 inch (25 mm)	
3/8 inch (9 mm)	100
No. 4 (4.75 mm)	95 – 100
No. 8 (2.36 mm)	
No. 16 (1.18 mm)	45 – 80
No. 50 (0.30 mm)	10 – 30
No. 100 (0.15 mm)	0 – 10

When two courses of porous backfill are specified in the plans, the finer of the materials shall conform to particle size tabulated herein for porous material No. 1. The coarser granular material shall meet the gradation given in the tabulation for porous material No. 2.

2.6. Granular material. Granular material used for backfilling shall conform to the requirements of ASTM D2321 for Class IA, IB, or II materials, or shall meet the requirements of AASHTO Standard Specification for Highway Bridges Section 30.

2.7. Filter fabric. The filter fabric shall conform to the requirements of AASHTO M288 Class 2.

Table 2

Fabric Property	Test Method	Test Requirement
Grab Tensile Strength, lbs	ASTM D4632	125 min
Grab Tensile Elongation %	ASTM D4632	50 min
Burst Strength, psi	ASTM D3785	125 min
Trapezoid Tear Strength, lbs	ASTM D4533	55 min
Puncture Strength, lbs	ASTM D4833	40 min
Abrasion, lbs	ASTM D4886	15 max loss
Equivalent Opening Size	ASTM D4751	70-100
Permittivity sec^{-1}	ASTM D4491	0.80
Accelerated Weathering (UV Stability) (Strength Retained - %)	ASTM D4355 *(500 hrs exposure)	70

2.8. Controlled low-strength material (CLSM). CLSM is not allowed.

PART 3: CONSTRUCTION METHODS

3.1 Equipment. All equipment required for the construction of pipe underdrains shall be on the project, in good working condition, and approved by the Engineer before construction is permitted to start.

3.2 Excavation. The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but shall not be less than the external diameter of the pipe plus 6 inches (150 mm) on each side of the pipe. The trench walls shall be approximately vertical.

Where rock, hardpan, or other unyielding material is encountered, it shall be removed below the foundation grade for a depth of at least 4 inches (100 mm). The excavation below grade shall be backfilled with selected fine compressible material, such as silty clay or loam, and lightly compacted in layers not over 6 inches (150 mm) in uncompacted depth to form a uniform but yielding foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The Engineer shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

Excavated material not required or acceptable for backfill shall be disposed of by the Contractor as directed by the Engineer. The excavation shall not be carried below the required depth; if this occurs, the trench shall be backfilled at the Contractor's expense with material approved by the Engineer and compacted to the density of the surrounding material.

The pipe bed shall be shaped so at least the lower quarter of the pipe shall be in continuous contact with the bottom of the trench. Spaces for the pipe bell shall be excavated to allow the pipe barrel to support the entire weight of the pipe.

The Contractor shall do trench bracing, sheathing, or shoring necessary to perform and protect the excavation as required for safety and conformance to Federal, state and local laws. Unless otherwise provided, the bracing, sheathing, or shoring shall be removed by the Contractor after the backfill has reached at least 12 inches (300 mm) over the top of the pipe. The sheathing or shoring shall be pulled as the granular backfill is placed and compacted to avoid any unfilled spaces between the trench wall and the backfill material. The cost of bracing, sheathing, or shoring, and the removal of same, shall be included in the unit price bid per foot (meter) for the pipe.

3.3 Laying and installing pipe.

a. Concrete pipe. Not Used

b. Metal pipe. Not Used

c. PVC or polyethylene pipe. PVC or polyethylene pipe shall be installed in accordance with the requirements of ASTM D2321 or AASHTO Standard Specification for Highway Bridges Section 30. Perforations shall meet the requirements of AASHTO M252 or AASHTO M294 Class 2, unless otherwise indicated on the plans. The pipe shall be laid accurately to line and grade.

d. All types of pipe. The upgrade end of pipelines, not terminating in a structure, shall be plugged or capped as approved by the Engineer.

Unless otherwise shown on the plans, a 4 inch (100 mm) bed of granular backfill material shall be spread in the bottom of the trench throughout the entire length under all perforated pipe underdrains.

Pipe outlets for the underdrains shall be constructed when required or shown on the plans. The pipe shall be laid with tight-fitting joints. Porous backfill is not required around or over pipe outlets for underdrains. All connections to other drainage pipes or structures shall be made as required and in a satisfactory manner. If connections are not made to other pipes or structures, the outlets shall be protected and constructed as shown on the plans.

e. Filter fabric. The filter fabric shall be installed in accordance with the manufacturer's recommendations, or in accordance with AASHTO M288 Appendix, unless otherwise shown on the plans.

3.4 Mortar. The mortar shall be of the desired consistency for caulking and filling the joints of the pipe and for making connections to other pipes or to structures. Mortar that is not used within 45 minutes after water has been added shall be discarded. Retempering of mortar shall not be permitted.

3.5 Not used

3.6 Backfilling.

a. Earth. All trenches and excavations shall be backfilled soon after the pipes are installed, unless additional protection of the pipe is directed. The backfill material shall be select material from excavation or borrow and shall be approved by the Engineer. The select material shall be placed on each side of the pipe out to a distance of the nominal pipe diameter and one foot (30 cm) over the top of the pipe and shall be readily compacted. It shall not contain stones 3 inches (75 mm) or larger in size, frozen lumps, chunks of highly plastic clay, or any other material that is objectionable to the Engineer. The material shall be moistened or dried, as required to aid compaction. Placement of the backfill shall not cause displacement of the pipe. Thorough compaction under the haunches and along the sides to the top of the pipe shall be obtained.

The backfill shall be placed in loose layers not exceeding 6 inches (150 mm) in depth under and around the pipe, and not exceeding 8 inches (200 mm) over the pipe. Successive layers shall be added and thoroughly compacted by hand and pneumatic tampers, approved by the Engineer, until the trench is completely filled and brought to the planned elevation. Backfilling shall be done to avoid damaging top or side pressures on the pipe.

In embankments and other unpaved areas, the backfill shall be compacted per Item P-152 to the density required for embankments in unpaved areas. Under paved areas, the subgrade and any backfill shall be compacted per Item P-152 to the density required for embankments for paved areas.

b. Granular backfill. When granular backfill is required, placement in the trench and about the pipe shall be as shown on the plans. The granular backfill shall not contain an excessive amount of foreign matter, nor shall soil from the sides of the trench or from the soil excavated from the trench be allowed to filter into the granular backfill. When required by the Engineer, a template shall be used to properly place and separate the two sizes of backfill. The backfill shall be placed in loose layers not exceeding 6 inches (150 mm) in depth. The granular backfill shall be compacted by hand and pneumatic tampers to the requirements as given for embankment. Backfilling shall be done to avoid damaging top or side pressure on the pipe. The granular backfill shall extend to the elevation of the trench or as shown on the plans.

When perforated pipe is specified, granular backfill material shall be placed along the full length of the pipe. The position of the granular material shall be as shown on the plans. If the original material excavated from the trench is pervious and suitable, it shall be used in lieu of porous backfill No. 1.

If porous backfill is placed in paved or adjacent to paved areas before grading or subgrade operations is completed, the backfill material shall be placed immediately after laying the pipe. The depth of the granular backfill shall be not less than 12 inches (300 mm), measured from the top of the underdrain. During subsequent construction operations, a minimum depth of 12 inches (300 mm) of backfill shall be maintained over the underdrains. When the underdrains are to be completed, any unsuitable material shall be removed exposing the porous backfill. Porous backfill containing objectionable material shall be removed and replaced with suitable material. The cost of removing and replacing any unsuitable material shall be at the Contractor's expense.

If a granular subbase blanket course is used which extends several feet beyond the edge of paving to the outside edge of the underdrain trench, the granular backfill material over the underdrains shall be placed in the trench up to an elevation of 2 inches (50 mm) above the bottom surface of the granular subbase blanket course. Immediately prior to the placing of the granular subbase blanket course, the Contractor shall blade this excess trench backfill from the top of the trench onto the adjacent subgrade where it can be incorporated into the granular subbase blanket course. Any unsuitable material that remains over the underdrain trench shall be removed and replaced. The subbase material shall be placed to provide clean contact between the subbase material and the underdrain granular backfill material for the full width of the underdrain trench.

c. Controlled low-strength material (CLSM). CLSM is not allowed.

d. Deflection testing. The Engineer may at any time, notwithstanding previous material acceptance, reject or require re-installation of pipe that exceeds 5% deflection when measured in accordance with ASTM D2321, including Appendices.

705-3.7 Connections. When the plans call for connections to existing or proposed pipe or structures, these connections shall be watertight and made to obtain a smooth uniform flow line throughout the drainage system.

705-3.8 Cleaning and restoration of site. After the backfill is completed, the Contractor shall dispose of all surplus material, soil, and rubbish from the site. Surplus soil may be deposited in embankments, shoulders, or as directed by the Engineer. Except for paved areas of the airport, the Contractor shall restore all disturbed areas to their original condition.

PART 4: METHOD OF MEASUREMENT

4.1 The length of pipe shall be the number of linear feet of pipe underdrains in place, completed, and approved; measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. The several classes, types, and sizes shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipeline being measured.

4.2 The length of pipe shall be the number of linear feet of transverse pipes in place, completed, and approved; measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. The several classes, types, and sizes shall be measured

separately. All fittings shall be included in the footage as typical pipe sections in the pipeline being measured.

705-4.3 The quantity of cleanouts for underdrain system shall be measured for each cleanout installed and accepted, including vertical piping, fittings, plug, backfill, PCC collar, frame and lid.

PART 5: BASIS OF PAYMENT

5.1 Pipe underdrains, Complete. Pipe underdrains, complete (including porous backfill, fittings, and filter fabric) shall be made at the contract unit price per linear foot COMPLETE.

These prices shall be full compensation for furnishing all materials and for all preparation, excavation, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

5.2 Transverse Pipe, Complete. Transverse pipes, complete (including granular backfill & misc. fittings) shall be made at the contract unit price per linear foot COMPLETE.

These prices shall be full compensation for furnishing all materials and for all preparation, excavation, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

705-5.3 Edge drain cleanout. Payment will be made at the contract unit price per each cleanout installed.

Payment will be made under:

Item A26	4-inch Underdrain Pipe - per linear foot complete
Item A27	4-inch Transverse Pipe - per linear foot complete
Item A28	Edge Drain Cleanout – per each

MATERIAL REQUIREMENTS

ASTM A760	Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains
ASTM A762	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C444	Standard Specification for Perforated Concrete Pipe
ASTM C654	Standard Specification for Porous Concrete Pipe
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

ASTM F758	Standard Specification for Smooth Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe & Fittings Based on Controlled Inside Diameter
ASTM F949	Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM F2562	Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage
AASHTO M190	Standard Specification for Bituminous - Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M196	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
AASHTO M252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M288	Standard Specification for Geotextile Specification for Highway Applications
AASHTO M294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500- mm (12- to 60-in.) Diameter
AASHTO M304	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
AASHTO MP20	Standard Specification for Steel-Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 900-mm (12- to 36-in.) diameter
AASHTO	Standard Specifications for Highway Bridges

END OF ITEM D-705

Item D-751 Manholes, Catch Basins, Inlets and Inspection Holes

DESCRIPTION

751-1.1 This item shall consist of construction of manholes, catch basins, inlets, and inspection holes, in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the plans or required by the Engineer.

MATERIALS

751-2.1 Brick. The brick shall conform to the requirements of ASTM C32, Grade MS.

751-2.2 Mortar. Mortar shall consist of one part Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.

751-2.3 Concrete. Plain and reinforced concrete used in structures, connections of pipes with structures, and the support of structures or frames shall conform to the requirements of Item P-610.

751-2.4 Precast concrete pipe manhole rings. Precast concrete pipe manhole rings shall conform to the requirements of ASTM C478. Unless otherwise specified, the risers and offset cone sections shall have an inside diameter of not less than 36 inches (90 cm) nor more than 48 inches (120 cm). There shall be a gasket between individual sections and sections cemented together with mortar on the inside of the manhole.

751-2.5 Corrugated metal. Corrugated metal shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M36.

751-2.6 Frames, covers, and grates. The castings shall conform to one of the following requirements:

a. ASTM A48, Class 35B: Gray iron castings

b. ASTM A47: Malleable iron castings

c. ASTM A27: Steel castings

d. ASTM A283, Grade D: Structural steel for grates and frames

e. ASTM A536, Grade 65-45-12: Ductile iron castings

f. ASTM A897:Austempered ductile iron castings

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings, aircraft gear configuration and/or direct loading, specified.

Each frame and cover or grate unit shall be provided with fastening members to prevent it from being dislodged by traffic but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

751-2.7 Steps. The steps or ladder bars shall be gray or malleable cast iron or galvanized steel. The steps shall be the size, length, and shape shown on the plans and those steps that are not galvanized shall be given a coat of bituminous paint, when directed.

751-2.8 Precast inlet structures. Manufactured in accordance with and conforming to ASTM C1433.

CONSTRUCTION METHODS

751-3.1 Unclassified excavation.

a. The Contractor shall excavate for structures and footings to the lines and grades or elevations, shown on the plans, or as staked by the Engineer. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximately only; and the Engineer may direct, in writing, changes in dimensions or elevations of footings necessary for a satisfactory foundation.

b. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. Where concrete will rest on a surface other than rock, the bottom of the excavation shall not be disturb and excavation to final grade shall not be made until immediately before the concrete or reinforcing is placed.

c. The Contractor shall do all bracing, sheathing, or shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for the structure.

d. All bracing, sheathing, or shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall not disturb or damage finished masonry. The cost of removal shall be included in the unit price bid for the structure.

e. After excavation is completed for each structure, the Contractor shall notify the Engineer. No concrete or reinforcing steel shall be placed until the Engineer has approved the depth of the excavation and the character of the foundation material.

751-3.2 Brick structures.

a. Foundations. A prepared foundation shall be placed for all brick structures after the foundation excavation is completed and accepted. Unless otherwise specified, the base shall consist of reinforced concrete mixed, prepared, and placed in accordance with the requirements of Item P-610.

b. Laying brick. All brick shall be clean and thoroughly wet before laying so that they will not absorb any appreciable amount of additional water at the time they are laid. All brick shall be laid in freshly made mortar. Mortar not used within 45 minutes after water has been added shall be discarded. Retempering of mortar shall not be permitted. An ample layer of mortar shall be spread on the beds and a shallow furrow shall be made in it that can be readily closed by the laying of the brick. All bed and head joints shall be filled solid with mortar. End joints of stretchers and side or cross joints of headers shall be fully buttered with mortar and a shoved joint made to squeeze out mortar at the top of the joint. Any bricks that may be loosened after the mortar has taken its set, shall be removed, cleaned, and relaid with fresh mortar. No broken or chipped brick shall be used in the face, and no spalls or bats shall be used except where necessary to shape around irregular openings or edges; in which case, full bricks shall be placed at ends or corners where possible, and the bats shall be used in the interior of the course. In making closures, no piece of brick shorter than the width of a whole brick shall be used; and wherever practicable, whole brick shall be used and laid as headers.

c. Joints. All joints shall be filled with mortar at every course Exterior faces shall be laid up in advance of backing. Exterior faces shall be plastered or parged with a coat of mortar not less than 3/8 inch (9 mm) thick before the backing is laid up. Prior to parging, all joints on the back of face courses shall be cut flush. Unless otherwise noted, joints shall be not less than 1/4 inch (6 mm) nor more than 1/2 inch (12 mm) wide and the selected joint width shall be maintained uniform throughout the work.

d. Pointing. Face joints shall be neatly struck, using the weather-struck joint. All joints shall be finished properly as the laying of the brick progresses. When nails or line pins are used the holes shall be immediately plugged with mortar and pointed when the nail or pin is removed.

e. Cleaning. Upon completion of the work all exterior surfaces shall be thoroughly cleaned by scrubbing and washing with water. If necessary to produce satisfactory results, cleaning shall be done with a 5% solution of muriatic acid which shall then be rinsed off with liberal quantities of water.

f. Curing and cold weather protection. The brick masonry shall be protected and kept moist for at least 48 hours after laying the brick. Brick masonry work or pointing shall not be done when there is frost on the brick or when the air temperature is below 50°F (10°C) unless the Contractor has, on the project ready to use, suitable covering and artificial heating devices necessary to keep the atmosphere surrounding the masonry at a temperature of not less than 60°F (16°C) for the duration of the curing period.

751-3.3 Concrete structures. Concrete structures shall be built on prepared foundations, conforming to the dimensions and shape indicated on the plans. The construction shall conform to the requirements specified in Item P-610. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the Engineer before the concrete is placed.

All invert channels shall be constructed and shaped accurately to be smooth, uniform, and cause minimum resistance to flowing water. The interior bottom shall be sloped to the outlet.

751-3.4 Precast concrete structures. Precast concrete structures shall conform to ASTM C478. Precast concrete structures shall be constructed on prepared or previously placed slab foundations conforming to the dimensions and locations shown on the plans. All precast concrete sections necessary to build a completed structure shall be furnished. The different sections shall fit together readily. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall be smoothed to a uniform surface on both interior and exterior of the structure. The top of the upper precast concrete section shall be suitably formed and dimensioned to receive the metal frame and cover or grate, or other cap, as required. Provision shall be made for any connections for lateral pipe, including drops and leads that may be installed in the structure. The flow lines shall be smooth, uniform, and cause minimum resistance to flow. The metal steps that are embedded or built into the side walls shall be aligned and placed at vertical intervals of 12 inches (300 mm). When a metal ladder replaces the steps, it shall be securely fastened into position.

751-3.5 Corrugated metal structures. Corrugated metal structures shall be prefabricated. All standard or special fittings shall be furnished to provide pipe connections or branches with the correct dimensions and of sufficient length to accommodate connecting bands. The fittings shall be welded in place to the metal structures. The top of the metal structure shall be designed so that either a concrete slab or metal collar may be attached to allow the fastening of a standard metal frame and grate or cover. Steps or ladders shall be furnished as shown on the plans. Corrugated metal structures shall be constructed on prepared foundations, conforming to the dimensions and locations as shown on the plans. When indicated, the structures shall be placed on a reinforced concrete base.

751-3.6 Inlet and outlet pipes. Inlet and outlet pipes shall extend through the walls of the structures a sufficient distance beyond the outside surface to allow for connections. They shall be cut off flush with the wall on the inside surface of the structure, unless otherwise directed. For concrete or brick structures, mortar shall be placed around these pipes to form a tight, neat connection.

751-3.7 Placement and treatment of castings, frames, and fittings. All castings, frames, and fittings shall be placed in the positions indicated on the plans or as directed by the Engineer, and shall be set true to line and elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

When frames or fittings are placed on previously constructed masonry, the bearing surface of the masonry shall be brought true to line and grade and shall present an even bearing surface so the entire face or back of the unit will come in contact with the masonry. The unit shall be set in mortar beds and anchored to the masonry as indicated on the plans or as directed by the Engineer. All units shall set firm and secure.

After the frames or fittings have been set in final position, the concrete or mortar shall be allowed to harden for seven (7) days before the grates or covers are placed and fastened down.

751-3.8 Installation of steps. The steps shall be installed as indicated on the plans or as directed by the Engineer. When the steps are to be set in concrete, they shall be placed and secured in position before the concrete is placed. When the steps are installed in brick masonry, they shall be placed as the masonry is being built. The steps shall not be disturbed or used until the concrete or mortar has hardened for at least seven (7) days. After seven (7) days, the steps shall be cleaned and painted, unless they have been galvanized.

When steps are required with precast concrete structures, they shall be cast into the side of the sections at the time the sections are manufactured or set in place after the structure is erected by drilling holes in the concrete and cementing the steps in place.

When steps are required with corrugated metal structures, they shall be welded into aligned position at a vertical spacing of 12 inches (300 mm).

Instead of steps, prefabricated ladders may be installed. For brick or concrete structures, the ladder shall be held in place by grouting the supports in drilled holes. For metal structures, the ladder shall be secured by welding the top support to the structure and grouting the bottom support into drilled holes in the foundation or as directed by the Engineer.

751-3.9 Backfilling.

a. After a structure has been completed, the area around it shall be backfilled with approved material, in horizontal layers not to exceed 8 inches (200 mm) in loose depth, and compacted to the density required in Item P-152. Each layer shall be deposited evenly around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the Engineer.

b. Backfill shall not be placed against any structure until approved by the Engineer. For concrete structures, approval shall not be given until the concrete has been in place seven (7) days, or until tests establish that the concrete has attained sufficient strength to withstand any pressure created by the backfill and placing methods.

c. Backfill shall not be measured for direct payment. Performance of this work shall be considered an obligation of the Contractor covered under the contract unit price for the structure involved.

751-3.10 Cleaning and restoration of site. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as approved by the Engineer. The Contractor shall restore all disturbed areas to their original condition. The Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

METHOD OF MEASUREMENT

751-4.1 Manholes, catch basins, inlets, and inspection holes shall be measured by the unit.

BASIS OF PAYMENT

751-5.1 The accepted quantities of manholes, catch basins, inlets, and inspection holes will be paid for at the contract unit price per each in place when completed. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials; furnishing and installation of such specials and connections to pipes and other structures as may be required to complete the item as shown on the plans; and for all labor equipment, tools and incidentals necessary to complete the structure.

Payment will be made under:

Item A29 Catch Basin - per each

MATERIAL REQUIREMENT	
ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A897	Standard Specification for Austempered Ductile Iron Castings
ASTM C32	Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C1433	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers

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Item T-901 Seeding

PART 1: DESCRIPTION

1.1 This item shall consist of soil preparation, seeding, and fertilizing, the areas shown on the plans or as directed by the Engineer in accordance with these specifications.

PART 2: MATERIALS

2.1 Seed. The species and application rates of grass, legume, and cover-crop seed furnished shall be those stipulated herein. Seed shall conform to the requirements of Federal Specification JJJ-S-181, Federal Specification, Seeds, Agricultural.

Seed shall be furnished separately or in mixtures in standard containers labeled in conformance with the Agricultural Marketing Service (AMS) Seed Act and applicable state seed laws with the seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the Engineer duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within six (6) months of date of delivery. This statement shall include: name and address of laboratory, date of test, lot number for each kind of seed, and the results of tests as to name, percentages of purity and of germination, and percentage of weed content for each kind of seed furnished, and, in case of a mixture, the proportions of each kind of seed. Wet, moldy, or otherwise damaged seed will be rejected.

Seeds shall be applied as follows:

Botanical Name	Common Name	% By Weight	Rate of Application lb/acre
Lolium perenne L.	Dward Perennial Rye	40%	88 lbs
Festuca rubra	Creeping Red Fescue	40%	88 lbs
Festuca brevipila	Hard Fescue	20%	44 lbs

Seeding shall be performed during the period between March 1 to May 15, or between August 15 to October 1, inclusive, unless otherwise approved by the Engineer.

2.2 Lime. No requirement

2.3 Fertilizer. Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate and to the depth specified, and shall meet the requirements of applicable state laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one of the following forms:

a. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;

b. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or

c. A granular or pellet form suitable for application by blower equipment.

Fertilizers shall be 16-16-16 commercial fertilizer and shall be spread at the rate of 220 lb/acre.

2.4 Soil for repairs. The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the Engineer before being placed.

PART 3: CONSTRUCTION METHODS

3.1 Advance preparation and cleanup. After grading of areas has been completed and before applying fertilizer and ground limestone, areas to be seeded shall be raked or otherwise cleared of stones larger than 2 inches (50 mm) in any diameter, sticks, stumps, and other debris that might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes has occurred after the completion of grading and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage include filling gullies, smoothing irregularities, and repairing other incidental damage.

An area to be seeded shall be considered a satisfactory seedbed without additional treatment if it has recently been thoroughly loosened and worked to a depth of not less than 5 inches (125 mm) as a result of grading operations and, if immediately prior to seeding, the top 3 inches (75 mm) of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter, and if shaped to the required grade.

When the area to be seeded is sparsely sodded, weedy, barren and unworked, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily disposed of, and the soil then scarified or otherwise loosened to a depth not less than 5 inches (125 mm). Clods shall be broken and the top 3 inches (75 mm) of soil shall be worked into a satisfactory seedbed by discing, or by use of cultipackers, rollers, drags, harrows, or other appropriate means.

3.2 Dry application method. Not approved.

901-3.3 Wet application method.

a. General. The Contractor may elect to apply seed and fertilizer (and lime, if required) by spraying them on the previously prepared seedbed in the form of an aqueous mixture and by using the methods and equipment described herein. The rates of application shall be as specified in the special provisions.

b. Spraying equipment. The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50 gallons (190 liters) over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 100 gallons (380 liters) per minute at a pressure of 100 lb / sq inches (690 kPa). The pump shall be mounted in a line that will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipe lines shall be capable of providing clearance for 5/8 inch (16 mm) solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supporting stand in such a manner that it can be rotated through 360 degrees horizontally and inclined vertically from at least 20 degrees below to at least 60 degrees above the horizontal. There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over distance varying from 20 to 100 feet (6 to 30 m). One shall be a close-range ribbon nozzle, one a medium-range ribbon nozzle, and one a long-range jet

nozzle. For case of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 feet (15 m) in length shall be provided to which the nozzles may be connected.

c. Mixtures. Lime, if required, shall be applied separately, in the quantity specified, prior to the fertilizing and seeding operations. Not more than 220 pounds (100 kg) of lime shall be added to and mixed with each 100 gallons (380 liters) of water. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 220 pounds (100 kg) of these combined solids shall be added to and mixed with each 100 gallons (380 liters) of water.

All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. Brackish water shall not be used at any time. The Contractor shall identify to the Engineer all sources of water at least two (2) weeks prior to use. The Engineer may take samples of the water at the source or from the tank at any time and have a laboratory test the samples for chemical and saline content. The Contractor shall not use any water from any source that is disapproved by the Engineer following such tests.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within two (2) hours from the time they were mixed or they shall be wasted and disposed of at approved locations.

d. Spraying. Lime, if required, shall be sprayed only upon previously prepared seedbeds. After the applied lime mixture has dried, the lime shall be worked into the top 3 inches (75 mm), after which the seedbed shall again be properly graded and dressed to a smooth finish.

Mixtures of seed and fertilizer shall only be sprayed upon previously prepared seedbeds on which the lime, if required, shall already have been worked in. The mixtures shall be applied by means of a high-pressure spray that shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

Particular care shall be exercised to ensure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with specifications shall be used to cover specified sections of known area.

Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

On surfaces that are to be mulched as indicated by the plans or designated by the Engineer, seed and fertilizer applied by the spray method need not be raked into the soil or rolled. However, on surfaces on which mulch is not to be used, the raking and rolling operations will be required after the soil has dried.

3.4 Maintenance of seeded areas. The Contractor shall protect seeded areas against traffic or other use by warning signs or barricades, as approved by the Engineer. Surfaces gullied or otherwise damaged following seeding shall be repaired by regrading and reseeding as directed. The Contractor shall mow, water as directed, and otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the work.

When either the dry or wet application method outlined above is used for work done out of season, it will be required that the Contractor establish a good stand of grass of uniform color and density to the satisfaction of the Engineer. A grass stand shall be considered adequate when bare spots are one square foot (0.01 sq m) or less, randomly dispersed, and do not exceed 3% of the area seeded.

PART 4: METHOD OF MEASUREMENT

4.1 The measurement for seeding shall be to the nearest 0.1 acre. The quantity of seeding shall measured as the number of acres on the ground surface, complete and accepted.

PART 5: BASIS OF PAYMENT

5.1 Payment shall be made at the contract unit price per acre, to the nearest 0.1 acre, which price and payment shall be full compensation for furnishing and placing all material and for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Payment will be made under:

Item A30	Seeding - per acre

MATERIAL REQUIREMENTS

ASTM C602	Standard Specification for Agricultural Liming Materials
ASTM D977	Standard Specification for Emulsified Asphalt
FED SPEC	JJJ-S-181, Federal Specification, Seeds, Agricultural

END OF ITEM T-901

Item L-100 General

DESCRIPTION

100-1.1 This Item consists of general requirements for procurement of equipment related to the electrical work as specified herein and indicated on the Drawings.

EQUIPMENT AND MATERIALS

100-2.1 GENERAL.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified and listed under Advisory Circular (AC) 150/5345-53, Airport Lighting Equipment Certification Program.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

c. Manufacturer's certifications shall not relieve the Contractor of the Contractor's responsibility to provide materials in accordance with these specifications and acceptable to the Engineer. Materials supplied and/or installed that do not materially comply with these specifications shall be removed, when directed by the Engineer and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.

d. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. PDFs are preferred. Original catalog sheets or photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components or electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be boldly and clearly made with arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in project accruing directly or indirectly from late submissions or resubmissions of submittals.

e. Submittals for each type of powered equipment (signs, lights, regulators, beacons, wind cones, and similar) shall include the contact information for the nearest manufacturer authorized vendor of equipment in the Northwest region of the United States. Submittals shall also include the contact information for factory trained service personnel who will be available at the site within 24 hours if required by the airport maintenance or operations offices. Also provide contact information for the nearest spare parts warehouse location(s) that could provide materials within 24 hours on a will call customer pick-up, or on-site delivery basis.

f. All equipment shall also include all wire and cable connections, the furnishing and installing of all necessary conduits and fittings and all necessary mounting structures. It shall also include the testing of the installation and all incidentals necessary to place the lights in operation as completed units to the satisfaction of the Engineer.

g. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be under a single cover in electronic format, tabbed by specification section. The Engineer

reserves the right to reject any and all equipment, materials or procedures, which, in the Engineer's opinion, does not meet the system design standards and codes, specified herein.

h. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The 12 month warranty period shall not supersede longer warranty periods offered standard by the manufacturer, required elsewhere in the contract specifications, or required by the FAA for certain equipment. In example, the 4-year warranty period required in FAA Engineering Brief 67D, *Light Sources Other Than Incandescent and Xenon For Airport and Obstruction Lighting Fixtures*, for light fixtures shall remain in effect. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner. The Contractor shall be responsible to maintain an insulation resistance of 50 megohms minima, (1000V megger) with isolation transformers connected in new circuits and new segments of existing circuits through the end of the contract warranty period.

i. The contractor must ascertain that all lighting system components furnished (including FAA approved equipment) are compatible in all respects with each other and the remainder of the new/existing system. Any non-compatible components furnished by the contractor must be replaced at no additional cost to the airport sponsor with a similar unit that is approved by the engineer and compatible with the remainder of the airport lighting system.

j. When a specific type, style, class, etc., of FAA approved equipment is specified only that type, style, class, etc., will be acceptable, though equipment of other types, style, class, etc., may be FAA approved.

k. Refer to the below list for typical lead times on equipment. These will vary seasonally and by manufacturer. Contractor shall verify lead times for all equipment and notify project manager of any items whose lead times are significantly longer and will impact construction schedule. Three weeks is typical for the submittal review process.

   1. L-824 Cable (5kV, Type C) and connectors: In Stock
   2. L-849V(L) REIL: 8 weeks
   3. L-858(L) Signs: 6 weeks
   4. L-861E Runway Elevated End Lights: 4 weeks
   5. L-861T(L) Taxiway Elevated Edge Lights: 6 weeks
   6. L-867 Basecans: 4 weeks
   7. L-881(L) PAPI: 6 weeks

l. Submittals for each type of powered equipment (signs, lights, regulators, beacons, wind cones, and similar) shall include the contact information for the nearest manufacturer authorized vendor of equipment in the Northwest region of the United States. Submittals shall also include the contact information for factory trained service personnel who will be available at the site within 24 hours if required by the airport maintenance or operations offices. Also provide contact information for the nearest spare parts warehouse location(s) that could provide materials within 24 hours on a will call customer pick-up, or on-site delivery basis.

m. Submittals required for this project include as a minimum the following:

   1. L-100
      i. Index of equipment to be submitted
      ii. Buy American Certification for submitted equipment
   2. L-108
      i. L-824 cable

ii. #6 Ground wire
iii. Ground Rods
iv. L-823 primary plug-in splice kits
v. L-823 primary connector heat shrink tubing
vi. Splicer qualifications
vii. Electrical Tape

3. L-110

i. Steel conduit
ii. PVC conduit
iii. Warning tape

4. L-125

i. L-830 Isolation Transformer
ii. L-849V(L) REIL
iii. L-858(L) Signs
iv. L-861E Elevated Runway End Light
v. L-867 Basecans & Lids
vi. Anti-seize or coated bolts
vii. Transformer Support
viii. L-881(L) PAPI
ix. Series Cut Out Cabinet

100-2.2 REGULATORY REQUIREMENTS.

a. Airport lighting equipment and materials requiring FAA specifications shall have the prior approval of the Federal Aviation Administration, and be listed in the latest edition of Advisory Circular (AC) 150/5345–53, Appendix 3.

b. An electrical work permit is not required for this project. All project work is being performed solely on FAA authorized airfield equipment. The FAA specifications and regulations, which authorize this work are not enforced by State or local electrical inspectors.

c. Per Title 49 of the United State Code (49 USC §50101), the Buy American preference rules apply to all steel and manufactured goods paid for with FAA Airport Improvement Project (AIP) funds. This requirement is implemented through FAA Program Guidance Letter (PGL) 10-02. Contractor shall document compliance with this requirement concurrent with applicable product submittal as follows, and are encouraged to verify status of selected products when preparing their bids.

1. Certify, in writing, all products are wholly produced in the US of US materials, or
2. Obtain a waiver to use non-US produced products per PGL_10_02, or
3. Certify that all equipment that is being used on the project is on the current Nationwide Buy American conformance list on the FAA website.

100-3.1 TESTING.

a. The installation shall be fully tested in operation as a completed unit prior to acceptance. These tests shall include taking megger and voltage readings. The insulation resistance to ground of the beacon supply circuit shall be not less than 50 megohms. Testing equipment shall be furnished by the Contractor. Tests shall be conducted in the presence of the Engineer and shall be to the Engineer's satisfaction. The airfield lighting system shall be restored to service at the end of each work shift. The contractor shall check modified wiring for continuity, freedom from grounds, and perform a visual check that all lights and signs to be placed in service are working properly.

100-3.2 SAFETY AND PROTECTION.

a. All or a portion of the work covered by this Section is to be conducted within the Air Operations Area (AOA) at the airport. Restrictions and conditions necessary to maintain airfield and aircraft safety as required by FAA regulations, and as required to maintain efficient airport operations, may impose limitations upon the Contractor's methods and procedures. All construction personnel shall comply with airport regulations for movement of personnel and vehicles on the airfield.

b. Safety Measures To Be Taken: The Owner has not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to the means, methods, techniques, sequences or procedures required for the Contractor to perform his work. The Contractor will be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. The duty of the Owner to conduct construction observations of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures, in, on or near the construction site. It shall be the Contractor's responsibility to comply with applicable safety and health regulations for construction. The Contractor shall consult with the state or federal safety inspector for interpretation whenever in doubt as to whether safe conditions do or do not exist or whether he is or is not in compliance with state or federal regulations.

c. Protection: The Contractor shall take whatever measures are required to ensure that electrical safety and protection are maintained, including the proper covering, signage, and securing of "live" circuits.

d. Comply with applicable State of Washington safety rules and health standards, including WAC 296-44, WAC-294-45.

e. Electrical circuits shall be considered de-energized only under the following conditions:

   1. Switches connecting subject circuit to the energy supply are observed in the "open" position, with an air break, and safety-tagged in the "open" position.
   2. Electrically operated switches are visibly "open", blocked or racked in the "open" position, and safety-tagged "open".
   3. If the supply circuit break is not visible and clearly identified, the circuit shall be grounded. If the ground connection is not within sight of the work area, the ground connection shall be safety-tagged before proceeding with the Work.
   4. Long parallel cable runs can result in dangerous energy levels being transferred between energized and deenergized cables. When working on airfield lighting circuits, ensure all circuits are deenergized using methods noted above.

f. Use of Red Safety Tags:

   1. For protection of personnel working on circuits, safety tags shall be filled out and attached to any opened switch or equipment.

   2. Safety tags shall be removed only by the employee who placed the tag, or by another employee who has been authorized to remove the tag in writing by the employee who placed the tag. Removal of a safety tag placed by an airport employee who is not available to remove the tag at the time of need may be authorized by the Airport Maintenance Superintendent or his designated representative only after carefully checking that the circuit is ready to be energized.

   3. Equipment with a safety tag attached shall not be operated, and connections with a safety tag attached shall not be changed.

g. Insulated cables, operated at over 300 volts to ground, shall be handled when energized only with rubber gloves tested to 22,000 volts by a Washington State approved testing laboratory.

h. Insulated cables that have been in operation shall be checked for current, and shall be cut only with grounded cable shears, or shall be grounded by driving a grounded sharp tool through the shielding and the conductors before cutting.

i. All personnel working around energized electrical equipment operating at over 750 volts shall wear standard insulated, non-conducting hard hats and shall wear no garments with metallic zipper fasteners.

100-3.3 SALVAGE AND DISPOSAL.

a. The contractor shall give the Owner 48 hours notice prior to disposal of equipment removed from service. The Owner shall select those items that the airport elects to keep or salvage. The contractor shall be responsible for disposing of the remaining material at an off-site, licensed facility.

PART 4: METHOD OF MEASUREMENT

4.1 Electrical Miscellaneous

a. Electrical Miscellaneous shall be measured by the lump sum and shall consist of all equipment, materials, labor, and project requirements and expenses not included in other payment items.

PART 5: BASIS OF PAYMENT

5.1 Payment Items

a. Payment will be made at the contract unit price per lump sum for the items as noted, in place by the Contractor and accepted by the Engineer (and Utility if applicable). This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, necessary to complete this item.

Payment will be made under:

Item A31	Electrical Miscellaneous—per lump sum

END OF ITEM L-100

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Item L-108 Underground Power Cable for Airports

PART 1: DESCRIPTION

1.1 This item shall consist of furnishing and installing power cables that are direct buried and furnishing and/or installing power cables within conduit or duct banks per these specifications at the locations shown on the plans. It includes excavation and backfill of trench for direct-buried cables only. Also included are the installation of counterpoise wires, ground wires, ground rods and connections, cable splicing, cable marking, cable testing, and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the Engineer. This item shall not include the installation of duct banks or conduit, trenching and backfilling for duct banks or conduit, or furnishing or installation of cable for FAA owned/operated facilities. Requirements and payment for trenching and backfilling for the installation of underground conduit and duct banks is in Item L-110, Airport Underground Electrical Duct Banks and Conduits.

PART 2: EQUIPMENT AND MATERIALS

2.1 General

a. Airport lighting equipment and materials covered by advisory circulars (AC) shall be approved under the Airport Lighting Equipment Certification Program per AC 150/5345-53, current version.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the Engineer.

c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the Engineer) and replaced with materials that comply with these specifications at the Contractor's cost.

d. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. PDFs are preferred. Original catalog sheets or photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

e. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Engineer reserves the right to reject any and all equipment, materials, or procedures that do not meet the system design and the standards and codes, specified in this document.

f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner. The Contractor shall be responsible to maintain a minimum insulation resistance per AC 150/5340-26B, Maintenance Airport Visual aid Facilities, Table 5-1 and paragraph 5.1.3.1, with isolation transformers connected in new circuits and new segments of existing circuits through the end of the contract warranty period.

2.2 Cable

Underground cable for airfield lighting facilities (runway and taxiway lights and signs) shall conform to the requirements of AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits latest edition. Conductors for use on 6.6 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #8 American wire gauge AWG), L-824 Type C, 5,000 volts, nonshielded, L-824 conductors for use on the L-830 secondary of airfield lighting series circuits shall be sized in accordance with the manufacturer's recommendations. All other conductors shall comply with FAA and National Electric Code (NEC) requirements. Conductor sizes noted above shall not apply to leads furnished by manufacturers on airfield lighting transformers and fixtures.

Wire for electrical circuits up to 600 volts shall comply with Specification L-824 and/or Federal Specification J-C-30 and shall be type THWN-2, 75°C. Conductors for parallel (voltage) circuits shall be sized and installed in accordance with NFPA-70, National Electrical Code.

Unless noted otherwise, all 600-volt and less non-airfield lighting conductor sizes are based on a 75°C, THWN-2, 600 volt insulation, copper conductors, not more than three single insulated conductors, in raceway, in free air. The conduit/duct sizes are based on the use of THWN-2, 600 volt insulated conductors. The Contractor shall make the necessary increase in conduit/duct sizes for other types of wire insulation. In no case shall the conduit/duct size be reduced. The minimum power circuit wire size shall be #12 AWG. Control wire shall be the size identified in the plans.

Conductor sizes may have been adjusted due to voltage drop or other engineering considerations. Equipment provided by the Contractor shall be capable of accepting the quantity and sizes of conductors shown in the Contract Documents. All conductors, pigtails, cable step-down adapters, cable step-up adapters, terminal blocks and splicing materials necessary to complete the cable termination/splice shall be considered incidental to the respective pay items provided.

Cable type, size, number of conductors, strand and service voltage shall be as specified in the Contract Document.

2.3 Bare copper wire (counterpoise, bare copper wire ground and ground rods)

Wire for counterpoise or ground installations for airfield lighting systems shall be No. 6 AWG bare solid copper wire for counterpoise and/or No. 6 AWG insulated stranded for ground wire per ASTM B3 and ASTM B8, and shall be bare copper wire per ASTM B33. See AC 150/5340-30 for additional details about counterpoise and ground wire types and installation. For voltage powered circuits, the equipment ground conductor shall be minimum No. 6 AWG, 600V rated, Type XHHW insulated, green color, stranded copper equipment ground conductor.

Ground rods shall be UL Listed copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than 8 feet (2.4 m) long and 5/8 inch (16 mm) in diameter.

2.4 Cable connections

In-line connections or splices of underground primary cables shall be of the type called for on the plans, and shall be one of the types listed below. No separate payment will be made for cable connections.

a. The cast splice

For <600V Use Only: A cast splice, employing a plastic mold and using epoxy resin equivalent to that manufactured by 3M™ Company, "Scotchcast" Kit No. 82-B, or as manufactured by Hysol® Corporation, "Hyseal Epoxy Splice" Kit No. E1135, or an approved equivalent, used for potting the splice is acceptable.

b. The field-attached plug-in splice

Figure 3 of AC 150/5345-26, Specification for L-823 Plug and Receptacle, Cable Connectors, employing connector kits, is acceptable for field attachment to single conductor cable. It shall be the Contractor's responsibility to determine the outside diameter of the cable to be spliced and to furnish appropriately sized connector kits and/or adapters and heat shrink tubing with integral sealant.

c. The factory-molded plug-in splice

Specification for L-823 Connectors, Factory-Molded to Individual Conductors, is acceptable.

d. The taped or heat-shrink splice

For <600V Use Only Taped splices employing field-applied rubber, or synthetic rubber tape covered with plastic tape is acceptable. The rubber tape should meet the requirements of ASTM D4388 and the plastic tape should comply with Military Specification MIL-I-24391 or Commercial Item Description A-A-55809. Heat shrinkable tubing shall be heavy-wall, self-sealing tubing rated for the voltage of the wire being spliced and suitable for direct-buried installations. The tubing shall be factory coated with a thermoplastic adhesive-sealant that will adhere to the insulation of the wire being spliced forming a moisture- and dirt-proof seal. Additionally, heat shrinkable tubing for multi-conductor cables, shielded cables, and armored cables shall be factory kits that are designed for the application. Heat shrinkable tubing and tubing kits shall be manufactured by Tyco Electronics/ Raychem Corporation, Energy Division, or approved equivalent.

In all the above cases, connections of cable conductors shall be made using crimp connectors using a crimping tool designed to make a complete crimp before the tool can be removed. All L-823/L-824 splices and terminations shall be made per the manufacturer's recommendations and listings.

All connections of counterpoise, grounding conductors and ground rods shall be made by the exothermic process or approved equivalent, except that a light base ground clamp connector shall be used for attachment to the light base. See AC 150/5340-30 for additional information about methods of attaching a ground to a galvanized light base. All exothermic connections shall be made per the manufacturer's recommendations and listings.

2.5 Splicer qualifications

Every airfield lighting cable splicer shall be qualified in making airport cable splices and terminations on cables rated at or above 5,000 volts AC. The Contractor shall submit to the Engineer proof of the qualifications of each proposed cable splicer for the airport cable type and voltage level to be worked on. Cable splicing/terminating personnel shall have a minimum of three (3) years continuous experience in terminating/splicing medium voltage cable.

2.6 Concrete

Concrete for cable markers shall be per 2014 WSDOT Class 4000 cement concrete.

2.7 Flowable backfill

Flowable material used to backfill trenches for power cable trenches shall conform to the requirements of the 2014 WSDOT Standard Specification 2-09 for Controlled Density Fill (CDF).

2.8 Cable identification tags

Cable identification tags shall be made from a non-corrosive material with the circuit identification stamped or etched onto the tag. The tags shall be of the type as detailed on the plans.

2.9 Tape

Electrical tapes shall be Scotch™ Electrical Tapes –Scotch™ 88 (1-1/2 inch (38 mm) wide) and Scotch™ 130C® linerless rubber splicing tape (2-inch (50 mm) wide), as manufactured by the Minnesota Mining and Manufacturing Company (3M™), or an approved equivalent.

2.10 Electrical coating

Electrical coating shall be Scotchkote™ as manufactured by 3M™, or an approved equivalent.

2.11 Existing circuits - not used, all existing circuits to be demolished

2.12 Detectable warning tape

Plastic, detectable, American Wood Preservers Association (AWPA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend magnetic tape shall be polyethylene film with a metalized foil core and shall be 3-6 inches (75-150 mm) wide. Detectable tape is incidental to the respective bid item.

PART 3: CONSTRUCTION METHODS

3.1 General

The Contractor shall install the specified cable at the approximate locations indicated on the plans. Unless otherwise shown on the plans, all cable required to cross under pavements expected to carry aircraft loads shall be installed in concrete encased duct banks. Wherever possible, cable shall be run without splices, from connection to connection.

Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual isolation transformers. The Contractor shall be responsible for providing cable in continuous lengths for home runs or other long cable runs without connections unless otherwise authorized in writing by the Engineer or shown on the plans.

In addition to connectors being installed at individual isolation transformers, L-823 cable connectors for maintenance and test points shall be installed at locations shown on the plans. Cable circuit identification markers shall be installed on both sides of the L-823 connectors installed or at least once in each access point where L-823 connectors are not installed.

Provide not less than 3 feet (1 m) of cable slack on each side of all connections, isolation transformers, light units, and at points where cable is connected to field equipment. Where provisions must be made for testing or for future above grade connections, provide enough slack to allow the cable to be extended at least one foot (30 cm) vertically above the top of the access structure. This requirement (6 feet total slack, mimum) also applies where primary cable passes through empty light bases, junction boxes, and access structures to allow for future connections, or as designated by the Engineer.

Primary airfield lighting cables installed shall have cable circuit identification markers attached on both sides of each L-823 connector and on each airport lighting cable entering or leaving cable access points, such as manholes, hand holes, pull boxes, junction boxes, etc. Markers shall be of sufficient length for imprinting the cable circuit identification legend on one line, using letters not less than 1/4 inch (6 mm) in size. The cable circuit identification shall match the circuits noted on the construction plans.

3.2 Installation in duct banks or conduits

This item includes the installation of the cable in duct banks or conduit per the following paragraphs. The maximum number and voltage ratings of cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be per the latest version of the National Electric Code, or the code of the local agency or authority having jurisdiction.

The Contractor shall make no connections or splices of any kind in cables installed in conduits or duct banks.

Unless otherwise designated in the plans, where ducts are in tiers, use the lowest ducts to receive the cable first, with spare ducts left in the upper levels. Check duct routes prior to construction to obtain assurance that the shortest routes are selected and that any potential interference is avoided.

Duct banks or conduits shall be installed as a separate item per Item L-110, Airport Underground Electrical Duct Banks and Conduit. The Contractor shall run a mandrel through duct banks or conduit prior to installation of cable to ensure that the duct bank or conduit is open, continuous and clear of debris. The mandrel size shall be compatible with the conduit size. The Contractor shall swab out all conduits/ducts and clean light bases, manholes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed, the light bases and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, light bases, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor's expense. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Engineer of any blockage in the existing ducts.

The cable shall be installed in a manner that prevents harmful stretching of the conductor, damage to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape providing moisture-tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a conduit, all cable shall be pulled in the conduit at the same time. The pulling of a cable through duct banks or conduits may be accomplished by hand winch or power winch with the use of cable grips or pulling eyes. Maximum pulling tensions shall not exceed the cable manufacturer's recommendations. A non-hardening cable-pulling lubricant recommended for the type of cable being installed shall be used where required.

The Contractor shall submit the recommended pulling tension values to the Engineer prior to any cable installation. If required by the Engineer, pulling tension values for cable pulls shall be monitored by a dynamometer in the presence of the Engineer. Cable pull tensions shall be recorded by the Contractor and reviewed by the Engineer. Cables exceeding the maximum allowable pulling tension values shall be removed and replaced by the Contractor at the Contractor's expense.

The manufacturer's minimum bend radius or NEC requirements (whichever is more restrictive) shall apply. Cable installation, handling and storage shall be per manufacturer's recommendations. During cold weather, particular attention shall be paid to the manufacturer's minimum installation temperature. Cable shall not be installed when the temperature is at or below the manufacturer's minimum installation temperature. At the Contractor's option, the Contractor may submit a plan, for review by the Engineer, for heated storage of the cable and maintenance of an acceptable cable temperature during installation when temperatures are below the manufacturer's minimum cable installation temperature.

Cable shall not be dragged across base can or manhole edges, pavement or earth. When cable must be coiled, lay cable out on a canvas tarp or use other appropriate means to prevent abrasion to the cable jacket.

3.3 Installation of direct-buried cable in trenches – not used

3.4 Cable markers for direct-buried cable – not used

3.5 Splicing

Connections of the type shown on the plans shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:

a. Cast splices

For <600V Use Only: These shall be made by using crimp connectors for jointing conductors. Molds shall be assembled, and the compound shall be mixed and poured per the manufacturer's instructions and to the satisfaction of the Engineer.

b. Field-attached plug-in splices

These shall be assembled per the manufacturer's instructions. These splices shall be made by plugging directly into mating connectors. In all cases the joint where the connectors come together shall be wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (38 mm) on each side of the joint.

c. Factory-molded plug-in splices

These shall be made by plugging directly into mating connectors. In all cases, the joint where the connectors come together shall be wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (38 mm) on each side of the joint.

d. Taped or heat-shrink splices

For <600V Use Only: A taped splice shall be made in the following manner:

Bring the cables to their final position and cut so that the conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with 1/4 inch (6 mm) of bare conductor on each side of the connector. Prior to splicing, the two ends of the cable insulation shall be penciled using a tool designed specifically for this purpose and for cable size and type. Do not use emery paper on splicing operation since it contains metallic particles. The copper conductors shall be thoroughly cleaned. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with crimping tool that requires a complete crimp before tool can be removed. Test the crimped connection by pulling on the cable. Scrape the insulation to assure that the entire surface over which the tape will be applied (plus 3 inches (75 mm) on each end) is clean. After scraping wipe the entire area with a clean lint-free cloth. Do not use solvents.

Apply high-voltage rubber tape one-half lapped over bare conductor. This tape should be tensioned as recommended by the manufacturer. Voids in the connector area may be eliminated by highly elongating the tape, stretching it just short of its breaking point. Throughout the rest of the splice less tension should be used. Always attempt to exactly half-lap to produce a uniform buildup. Continue buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered a distance of approximately one inch (25 mm) over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Do not use glyptol or lacquer over vinyl tape as they react as solvents to the tape. No further cable covering or splice boxes are required.

Heat shrinkable tubing shall be installed following manufacturer's instructions. Direct flame heating shall not be permitted unless recommended by the manufacturer. Cable surfaces within the limits of the heat-shrink application shall be clean and free of contaminates prior to application.

Surfaces of equipment or conductors being terminated or connected shall be prepared in accordance with industry standard practice and manufacturer's recommendations. All surfaces to be connected shall be thoroughly cleaned to remove all dirt, grease, oxides, nonconductive films, or other foreign material. Paints and other nonconductive coatings shall be removed to expose base metal. Clean all surfaces at least 1/4 inch (6.4 mm) beyond all sides of the larger bonded area on all mating surfaces. Use a joint compound suitable for the materials used in the connection. Repair painted/coated surface to original condition after completing the connection.

3.6 Bare counterpoise wire installation for lightning protection and grounding

If shown on the plans or included in the job specifications, bare solid #6 AWG copper counterpoise wire shall be installed for lightning protection of the underground cables.

Counterpoise wire shall be installed in the same trench for the entire length of buried cable, conduits and duct banks that are installed to contain airfield cables.

The counterpoise conductor shall be installed no less than 8 inches (203 mm) above the raceway or cable to be protected, except as permitted below.

The minimum counterpoise conductor height above the raceway or cable to be protected shall be permitted to be adjusted subject to coordination with the airfield lighting and pavement designs.

The counterpoise conductor shall be installed no more than 12 inches (305 mm) above the raceway or cable to be protected.

The counterpoise conductor shall be bonded to each metallic light base, mounting stake, and metallic airfield lighting component.

All metallic airfield lighting components in the field circuit on the output side of the constant current regulator (CCR) or other power source shall be bonded to the airfield lighting counterpoise system.

The counterpoise wire shall also be exothermically welded to ground rods installed as shown on the plans but not more than 500 feet (150 m) apart around the entire circuit. The counterpoise system shall be continuous and terminate at the transformer vault or at the power source. It shall be securely attached to the vault or equipment external ground ring or other made electrode-grounding system. The connections shall be made as shown on the plans and in the specifications.

3.7 Counterpoise installation above multiple conduits and duct banks

Counterpoise wires shall be installed above multiple conduits/duct banks for airfield lighting cables, with the intent being to provide a complete area of protection over the airfield lighting cables. When multiple conduits and/or duct banks for airfield cable are installed in the same trench, the number and location of counterpoise wires above the conduits shall be adequate to provide a complete cone of protection measured 22-1/2 degrees each side of vertical.

Where duct banks pass under pavement to be constructed in the project, the counterpoise shall be placed above the duct bank. Reference details on the construction plans.

3.8 Counterpoise installation at existing duct banks – not used

3.9 Exothermic bonding. Bonding of counterpoise wire shall be by the exothermic welding process. Only personnel experienced in and regularly engaged in this type of work shall make these connections.

Contractor shall demonstrate to the satisfaction of the Engineer, the welding kits, materials and procedures to be used for welded connections prior to any installations in the field. The installations shall comply with the manufacturer's recommendations and the following:

a. All slag shall be removed from welds.

b. Using an exothermic weld to bond the counterpoise to a lug on a galvanized light base is not recommended unless the base has been specially modified. Consult the manufacturer's installation directions for proper methods of bonding copper wire to the light base. See also AC 150/5340-30 for galvanized light base exception.

c. If called for in the plans, all buried copper and weld material at weld connections shall be thoroughly coated with 6 mm of 3M™ Scotchkote™, or approved equivalent, or coated with coal tar Bitumastic® material to prevent surface exposure to corrosive soil or moisture.

3.10 Testing

The Contractor shall furnish all necessary equipment and appliances for testing the airport electrical systems and underground cable circuits before and after installation. The Contractor shall perform all tests in the presence of the Engineer. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the Engineer. All costs for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase. The Contractor must maintain the test results throughout the entire project as well as during the warranty period that meet the following:

a. Earth resistance testing methods shall be submitted to the Engineer for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the Engineer. All such testing shall be at the sole expense of the Contractor.

b. Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The Engineer shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

After installation, the Contractor shall test and demonstrate to the satisfaction of the Engineer the following:

c. That all affected lighting power and control circuits (existing and new) are continuous and free from short circuits.

d. That all affected circuits (existing and new) are free from unspecified grounds.

e. That the insulation resistance to ground of all new non-grounded high voltage series circuits or cable segments is not less than 50 megohms.

f. That the insulation resistance to ground of all new non-grounded conductors of new multiple circuits or circuit segments is not less than 100 megohms.

g. That all affected circuits (existing and new) are properly connected per applicable wiring diagrams.

h. That all affected circuits (existing and new) are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

i. That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the Engineer prior to performing the testing.

Two copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the Engineer. Where connecting new cable to existing cable, ground resistance tests shall be performed on the new cable prior to connection to the existing circuit.

There are no approved “repair” procedures for items that have failed testing other than complete replacement.

PART 4: METHOD OF MEASUREMENT

4.1 Cable or wire installed in duct bank or conduit shall be measured by the number of linear feet (meters) installed and ready for operation, and accepted as satisfactory. Separate measurement shall be made for each cable or wire installed in trench, duct bank or conduit. The measurement for this item shall include additional quantities required for slack, routing through handholes, and all other locations required for a complete assembly.

4.2 Ground bonds and counterpoise wire/cable shall be incidental to the associated equipment or conduit/duct, and no separate measurement or payment shall be made.

4.3 Ground rods shall be considered incidental to the system or component to which they are connected, and no separate payment shall be made.

PART 5: BASIS OF PAYMENT

5.1 Payment will be made at the contract unit price for trenching, cable and bare counterpoise wire installed in trench (direct-buried), or cable and equipment ground installed in duct bank or conduit, in place by the Contractor and accepted by the Engineer. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, including ground rods and ground connectors and trench marking tape, necessary to complete this item.

Payment will be made under:

Item A32	No. 8 AWG 5 kV, L-824, Type C Cable - per linear foot
Item A33	No. 10 AWG 600V L-824 - per linear foot

MATERIAL REQUIREMENTS

AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-53	Airport Lighting Equipment Certification Program
Commercial Item Description A-A-59544	Cable and Wire, Electrical (Power, Fixed Installation)
Commercial Item Description A-A-55809	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic
ASTM B3	Standard Specification for Soft or Annealed Copper Wire
ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
ASTM D4388	Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes
FED SPEC J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
MIL-I-24391	Insulation Tape, Electrical, Plastic, Pressure Sensitive

REFERENCE DOCUMENTS

NFPA-70	National Electrical Code (NEC)
NFPA-780	Standard for the Installation of Lightning Protection Systems
MIL-S-23586F	Performance Specification: Sealing Compound (with Accelerator), Silicone Rubber, Electrical
ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

END OF ITEM L-108

Item L-110 Airport Underground Electrical Duct Banks and Conduits

PART 1: DESCRIPTION

1.1 This item shall consist of underground electrical conduits and duct banks (single or multiple conduits encased in concrete or buried in sand) installed per this specification at the locations and per the dimensions, designs, and details shown on the plans. This item shall include furnishing and installing of all underground electrical duct banks and individual and multiple underground conduits. It shall also include all turfing trenching, backfilling, removal, and restoration of any paved or turfed areas; concrete encasement, mandrelling, pulling lines, duct markers, plugging of conduits, and the testing of the installation as a completed system ready for installation of cables per the plans and specifications. This item shall also include furnishing and installing conduits and all incidentals for providing positive drainage of the system. Verification of existing ducts is incidental to the pay items provided in this specification.

PART 2: EQUIPMENT AND MATERIALS

2.1 General

a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

b. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications and acceptable to the Engineer. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Engineer and replaced with materials that comply with these specifications, at the Contractor's cost.

c. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. PDFs are preferred. Original catalog sheets or photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in project that accrue directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Engineer reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes specified in this document.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

2.2 Steel conduit

Rigid galvanized steel (RGS) conduit and fittings shall be hot dipped galvanized inside and out and conform to the requirements of Underwriters Laboratories Standards 6, 514B, and 1242. All RGS conduits or RGS elbows installed below grade, in concrete, permanently wet locations or other similar environments shall be painted with a 10 mil thick coat of asphaltum sealer or shall

have a factory bonded polyvinyl chloride (PVC) cover. Any exposed galvanizing or steel shall be coated with 10 mil of asphaltum sealer. When using PVC coated RGS conduit, care shall be exercised not to damage the factory PVC coating. Damaged PVC coating shall be repaired per the manufacturer's written instructions.

2.3 Plastic conduit

Plastic conduit and fittings-shall conform to the following requirements:

- UL 514B covers W-C-1094-Conduit fittings all types, classes 1 thru 3 and 6 thru 10.
- UL 514C covers W-C-1094- all types, Class 5 junction box and cover in plastic (PVC).
- UL 651 covers W-C-1094-Rigid PVC Conduit, types I and II, Class 4.
- UL 651A covers W-C-1094-Rigid PVC Conduit and high density polyethylene (HDPE) Conduit type III and Class 4.

Underwriters Laboratories Standards UL-651 and Article 352 of the current National Electrical Code shall be one of the following, as shown on the plans:

a. Type I–Schedule 40 PVC suitable for underground use either direct-buried or encased in concrete.

b. Type II–Schedule 40 PVC suitable for either above ground or underground use.

c. Type III – Schedule 80 PVC suitable for either above ground or underground use either direct-buried or encased in concrete.

d. Type III –HDPE pipe, minimum standard dimensional ratio (SDR) 11, suitable for placement with directional boring under pavement.

The type of solvent cement shall be as recommended by the conduit/fitting manufacturer.

2.4 Split conduit

Split conduit shall be pre-manufactured for the intended purpose and shall be made of steel or plastic.

2.5 Conduit spacers

Conduit spacers shall be prefabricated interlocking units manufactured for the intended purpose. They shall be of double wall construction made of high grade, high density polyethylene complete with interlocking cap and base pads, They shall be designed to accept No. 4 reinforcing bars installed vertically.

2.6 Concrete

Concrete shall conform to 2014 WSDOT Class 4000 cement concrete.

2.7 Flowable backfill

Flowable material used to back fill conduit and duct bank trenches shall conform to the requirements of the 2014 WSDOT Standard Specification 2-09 for Controlled Density Fill (CDF).

2.8 Detectable warning tape

Plastic, detectable, American Wood Preservers Association (AWPA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend magnetic tape shall be polyethylene film with a metallized foil core and shall be 3-6 inches (75-150 mm) wide. Detectable tape is incidental to the respective bid item.

PART 3: CONSTRUCTION METHODS

3.1 General

The Contractor shall install underground duct banks and conduits at the approximate locations indicated on the plans. The Engineer shall indicate specific locations as the work progresses, if required to differ from the plans. Duct banks and conduits shall be of the size, material, and type indicated on the plans or specifications. Where no size is indicated on the plans or in the specifications, conduits shall be not less than 2 inches (50 mm) inside diameter or comply with the National Electrical Code based on cable to be installed, whichever is larger. All duct bank and conduit lines shall be laid so as to grade toward access points and duct or conduit ends for drainage. Unless shown otherwise on the plans, grades shall be at least 3 inches (75 mm) per 100 feet (30 m). On runs where it is not practicable to maintain the grade all one way, the duct bank and conduit lines shall be graded from the center in both directions toward access points or conduit ends, with a drain into the storm drainage system. Pockets or traps where moisture may accumulate shall be avoided. No duct bank or underground conduit shall be less than 18 inches (0.5 m) below finished grade. Where under pavement, the top of the duct bank shall not be less than 18 inches (0.5 m) below the subgrade.

The Contractor shall mandrel each individual conduit whether the conduit is direct-buried or part of a duct bank. An iron-shod mandrel, not more than 1/4 inch (6 mm) smaller than the bore of the conduit shall be pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than the conduit hole.

The Contractor shall swab out all conduits/ducts and clean base can, manhole, pull boxes, etc., interiors IMMEDIATELY prior to pulling cable. Once cleaned and swabbed the light bases, manholes, pull boxes, etc., and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, base cans, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be recleaned at the Contractor's expense. All accessible points shall be kept closed when not installing cable. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Engineer of any blockage in the existing ducts.

For pulling the permanent wiring, each individual conduit, whether the conduit is direct-buried or part of a duct bank, shall be provided with a 200 pound (90 kg) test polypropylene pull rope. The ends shall be secured and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare conduits are installed, as indicated on the plans, the open ends shall be plugged with removable tapered plugs, designed for this purpose.

All conduits shall be securely fastened in place during construction and shall be plugged to prevent contaminants from entering the conduits. Any conduit section having a defective joint shall not be installed. Ducts shall be supported and spaced apart using approved spacers at intervals not to exceed 5 feet (1.5 m).

Unless otherwise shown on the plans, concrete encased duct banks shall be used when crossing under pavements expected to carry aircraft loads, such as runways, taxiways, taxilanes, ramps and aprons. When under paved shoulders and other paved areas, conduit and duct banks shall be encased using flowable fill for protection.

All conduits within concrete encasement of the duct banks shall terminate with female ends for ease in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.

Trenches for conduits and duct banks may be excavated manually or with mechanical trenching equipment unless in pavement, in which case they shall be excavated with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall not be used to excavate the trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches (75 mm) below the required conduit or duct bank depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4 inch (6 mm) sieve. Flowable backfill may alternatively be used The Contractor shall ascertain the type of soil or rock to be excavated before bidding. All such rock removal shall be performed and paid for under Item P-152.

Underground electrical warning (Caution) tape shall be installed in the trench above all underground duct banks and conduits in unpaved areas. Contractor shall submit a sample of the proposed warning tape for approval by the Engineer. If not shown on the plans, the warning tape shall be located 6 inches above the duct/conduit or the counterpoise wire if present.

Joints in plastic conduit shall be prepared per the manufacturer's recommendations for the particular type of conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly. Where more than one conduit is placed in a single trench, or in duct banks, joints in the conduit shall be staggered a minimum of 2 feet (60 cm).

Changes in direction of runs exceeding 10 degrees, either vertical or horizontal, shall be accomplished using manufactured sweep bends.

Whether or not specifically indicated on the drawings, where the soil encountered at established duct bank grade is an unsuitable material, as determined by the Engineer, the unsuitable material shall be removed per Item P-152 and replaced with suitable material. Alternatively, additional duct bank supports that are adequate and stable shall be installed, as approved by the Engineer.

All excavation shall be unclassified and shall be considered incidental to the respective L-110 pay item of which it is a component part. Dewatering necessary for duct installation, erosion and turbidity control, per Federal, state, and local requirements is incidental to its respective pay item as a part of Item L-110. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid for the L-110 Item.

Unless otherwise specified, excavated materials that are deemed by the Engineer to be unsuitable for use in backfill or embankments shall be removed and disposed of offsite.

Any excess excavation shall be filled with suitable material approved by the Engineer and compacted per Item P-152.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables) cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the plans. Installation of new cable where such crossings must occur shall proceed as follows:

a. Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred

b. Trenching, etc., in cable areas shall then proceed with approval of the Engineer, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair.

3.2 Duct banks

Unless otherwise shown in the plans, duct banks shall be installed so that the top of the concrete envelope is not less than 18 inches (0.5 m) below the bottom of the base or stabilized base course layers where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches (0.5 m) below finished grade where installed in unpaved areas.

Unless otherwise shown on the plans, duct banks under paved areas shall extend at least 3 feet (1 m) beyond the edges of the pavement or 3 feet (1 m) beyond any under drains that may be installed alongside the paved area. Trenches for duct banks shall be opened the complete length before concrete is placed so that if any obstructions are encountered, provisions can be made to avoid them. Unless otherwise shown on the plans, all duct banks shall be placed on a layer of concrete not less than 3 inches (75 mm) thick prior to its initial set. The Contractor shall space the conduits not less than 3 inch (75 mm) apart (measured from outside wall to outside wall). All such multiple conduits shall be placed using conduit spacers applicable to the type of conduit. As the conduit laying progresses, concrete shall be placed around and on top of the conduits not less than 3 inches (75 mm) thick unless otherwise shown on the plans. All conduits shall terminate with female ends for ease of access in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Conduits forming the duct bank shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches (150 mm) to anchor the assembly into the earth prior to placing the concrete encasement. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot (1.5-m) intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

When specified, the Contractor shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When directed, the Contractor shall supply additional supports where the ground is soft and boggy, where ducts cross under roadways, or where shown on the plans. Under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers, or piles located at approximately 5-foot (1.5-m) intervals.

All pavement surfaces that are to have ducts installed therein shall be neatly saw cut to form a vertical face. All excavation shall be included in the contract with price for the duct.

Install a plastic, detectable, color as noted, 3 to 6 inches (75 to 150 mm) wide tape, 8 inches (200 mm) minimum below grade above all underground conduit or duct lines not installed under pavement. Utilize the 3-inch (75-mm) wide tape only for single conduit runs. Utilize the 6-inch (150-mm) wide tape for multiple conduits and duct banks. For duct banks equal to or greater than 24 inches (600 mm) in width, utilize more than one tape for sufficient coverage and identification of the duct bank as required.

When existing cables are to be placed in split duct, encased in concrete, the cable shall be carefully located and exposed by hand tools. Prior to being placed in duct, the Engineer shall be notified so that he may inspect the cable and determine that it is in good condition. Where required, split duct shall be installed as shown on the drawings or as required by the Engineer.

3.3 Conduits without concrete encasement

Trenches for single-conduit lines shall be not less than 6 inches (150 mm) nor more than 12 inches (300 mm) wide. The trench for 2 or more conduits installed at the same level shall be proportionately wider. Trench bottoms for conduits without concrete encasement shall be made to conform accurately to grade so as to provide uniform support for the conduit along its entire length.

Unless otherwise shown on the plans, a layer of fine earth material, at least 4 inches (100 mm) thick (loose measurement) shall be placed in the bottom of the trench as bedding for the conduit. The bedding material shall consist of soft dirt, sand or other fine fill, and it shall contain no particles that would be retained on a 1/4 inch (6 mm) sieve. The bedding material shall be tamped until firm. Flowable backfill may alternatively be used.

Unless otherwise shown on plans, conduits shall be installed so that the tops of all conduits within the Airport's secured area where trespassing is prohibited are at least 18 inches (0.5 m) below the finished grade. Conduits outside the Airport's secured area shall be installed so that the tops

of the conduits are at least 24 inches (60 cm) below the finished grade per National Electric Code (NEC), Table 300.5.

When two or more individual conduits intended to carry conductors of equivalent voltage insulation rating are installed in the same trench without concrete encasement, they shall be spaced not less than 3 inches (75 mm) apart (measured from outside wall to outside wall) in a horizontal direction and not less than 6 inches (150 mm) apart in a vertical direction. Where two or more individual conduits intended to carry conductors of differing voltage insulation rating are installed in the same trench without concrete encasement, they shall be placed not less than 3 inches (75 mm) apart (measured from outside wall to outside wall) in a horizontal direction and lot less than 6 inches (150 mm) apart in a vertical direction.

Trenches shall be opened the complete length between normal termination points before conduit is installed so that if any unforeseen obstructions are encountered, proper provisions can be made to avoid them.

Conduits shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches (150 mm) to anchor the assembly into the earth while backfilling. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot (1.5-m) intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

3.4 Markers

The location of each end and of each change of direction of conduits and duct banks shall be marked by a concrete slab marker 2 feet (60 cm) square and 4 - 6 inches (100 - 150 mm) thick extending approximately one inch (25 mm) above the surface. The markers shall also be located where indicated on the plans.

The Contractor shall impress the word “DUCT” or “CONDUIT” on each marker slab. Impression of letters shall be done in a manner, approved by the Engineer, for a neat, professional appearance. All letters and words must be neatly stenciled. After placement, all markers shall be given one coat of high-visibility orange paint, as approved by the Engineer. The Contractor shall also impress on the slab the number and size of conduits beneath the marker along with all other necessary information as determined by the Engineer. The letters shall be 4 inches (100 mm) high and 3 inches (75 mm) wide with width of stroke 1/2 inch (12 mm) and 1/4 inch (6 mm) deep or as large as the available space permits. Furnishing and installation of duct markers is incidental to the respective duct pay item.

3.5 Backfilling for conduits

For conduits, 8 inches (200 mm) of sand, soft earth, or other fine fill (loose measurement) shall be placed around the conduits ducts and carefully tamped around and over them with hand tampers. The remaining trench shall then be backfilled and compacted per Item P-152 “Excavation and Embankment” except that material used for back fill shall be select material not larger than 4 inches (100 mm) in diameter.

Flowable backfill may alternatively be used.

Trenches shall not contain pools of water during back filling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the Engineer.

3.6 Backfilling for duct banks

After the concrete has cured, the remaining trench shall be backfilled and compacted per Item P-152 “Excavation and Embankment” except that the material used for backfill shall be select

material not larger than 4 inches (100 mm) in diameter. In addition to the requirements of P-152, where duct banks are installed under pavement, one moisture/density test per lift shall be made for each 250 linear feet (76 m) of duct bank or one work period's construction, whichever is less.

Flowable backfill may alternatively be used.

Trenches shall not contain pools of water during backfilling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the Engineer.

3.7 Restoration

Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The restoration shall include seeding **or as** shown on the plans. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. All restoration shall be considered incidental to the respective L-110 pay item. Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

PART 4: METHOD OF MEASUREMENT

4.1 Underground conduits and duct banks shall be measured by the linear feet (meter) of conduits and duct banks installed, including encasement, locator tape, trenching and backfill with designated material, and for drain lines, the termination at the drainage structure, all measured in place, completed, and accepted. Separate measurement shall be made for the various types and sizes.

PART 5: BASIS OF PAYMENT

5.1 Payment will be made at the contract unit price per linear foot for each type and size of conduit and duct bank completed and accepted, including trench and backfill with the designated material, and, for drain lines, the termination at the drainage structure. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item per the provisions and intent of the plans and specifications.

Payment will be made under:

Item A34 **(1) 2" PVC Sch 40, Direct Bury** - per linear foot

Item A35 **(1) 2" PVC Sch 40, Concrete Encased** - per linear foot

MATERIAL REQUIREMENTS

Advisory Circular (AC) 150/5340-30
Design and Installation Details for Airport Visual Aids

AC 150/5345-53 Airport Lighting Equipment Certification Program

ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m^3))
ASTM D2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
NFPA-70	National Electrical Code (NEC)

Underwriters Laboratories Standard 6
Electrical Rigid Metal Conduit - Steel

Underwriters Laboratories Standard 514B
Conduit, Tubing, and Cable Fittings

Underwriters Laboratories Standard 514C
Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

Underwriters Laboratories Standard 1242
Electrical Intermediate Metal Conduit Steel

Underwriters Laboratories Standard 651
Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings

Underwriters Laboratories Standard 651A
Type EB and A Rigid PVC Conduit and HDPE Conduit

END OF ITEM L-110

Item L-125 Installation of Airport Lighting Systems

DESCRIPTION

1.1 This item consists of airport lighting systems furnished and installed in accordance with this Item, related Items, and the applicable Advisory Circulars. The systems are installed at the location and in accordance with the dimensions, design, and details shown in the Contract Documents. This Work includes furnishing of all equipment, materials, services, and incidentals necessary to place the systems in operation as completed units.

1.2 This item includes:

a. Isolation Transformers: L-830-#, size to match equipment served.
b. REIL: L-849V(L), Runway End Identifier Lights
c. Guidance Signs: L-858(L), refer to the drawings for legend and schedules.
d. Runway End Lights: L-861E Runway End/Threshold Light, Elevated, Medium Intensity.
e. Taxiway Edge Lights: L-861T(L) Taxiway Edge Light, Elevated, Omnidirectional, blue
f. Base Cans: L-867
g. PAPI: L-881(L), Precision Approach Path Indicator
h. SCO Cabinet

PART 2: EQUIPMENT AND MATERIALS

2.1 GENERAL – See Item L-100, General

2.2 ISOLATION TRANSFORMERS.

a. New isolation transformers for the 6.6 amp series lighting shall be FAA approved type L-830 and in compliance with FAA specification AC 150/5345-47 “Isolation Transformers for Airport Lighting Systems.” Transformers shall be of the size and type recommended by the manufacturer of the product being powered.

2.3 RUNWAY END IDENTIFIER LIGHTS (REIL)

a. Shall be L-849V(L)V/I (AC 150/5345-51), Style C (Low Intensity), 240V input REIL from a manufacturer listed in AC 150/5345-53 "Approved Airport Equipment." All REILs shall be the product of a single manufacturer.

2.4 GUIDANCE SIGNS.

a. The guidance signs shall conform to the most recent edition of AC 150/5345-44.

b. All new lighted signs shall be L-858(L), 6.6A, Style 2 (3-step), size and legend as noted on the plans.

1. Signs shall have sections or panels which are removable to allow for cleaning the complete interior of the sign. The removable portion shall completely separate from the remainder of the sign.
2. The signs shall be modular in construction. Sign face material shall be polycarbonate plastic material capable of being fabricated locally. Signs shall incorporate retroreflective material for increased visibility. Each sign shall include frangible couplings for safety.
3. Wiring shall be secured and protected from rubbing and chaffing.
4. If lamp current or voltage adjustments are to be made, access shall be provided so the work can be done by one person without kneeling or lying down. Screw type adjustments shall include guides and barriers to prevent contact with any live components.

5. Signs shall be sealed to prevent blowing rain, snow and dust from entering the sign under the conditions at the Airport where they will be installed.

2.5 RUNWAY END LIGHTS.

a. New runway end lights shall conform to the most recent edition of AC 150/5345-46, and shall be a make and model listed in the current A/C 150/5345-53. Each light shall be furnished with the manufacturer's recommended size new L-830 transformer and baseplate and gasket to mount on L-867 or L-868 base can.

b. New runway end lights shall be L-861E base can mounted (Class 2), 6.6A (Mode 1), 14-inch high, using quartz 45W bulbs.

2.6 TAXIWAY EDGE LIGHTS

a. New taxiway edge lights shall conform to the most recent edition of AC 150/5345-46, and shall be a make and model listed in the current A/C 150/5345-53. Each light shall be furnished with the manufacturer's recommended size new L-830 transformer and baseplate and gasket to mount on L-867 or L-868 base can.

b. New taxiway edge lights shall be L-861T(L) base can mounted (Class 2), 6.6A (Mode 1), 14-inch high, omnidirectional LED.

2.7 BASE CANS.

a. All new light bases shall be FAA approved L-867 base cans and related supplies meeting the requirements of FAA AC 150/5345-42 (latest edition) "Specification for Airport Light Base and Transformer Housings, Junction Boxes, and Accessories."

b. L-867 base cans shall be Class I, steel; Size B, 12-inch diameter, 24-inches deep with 1/2-inch diameter drain hole in the bottom. Base can conduit connections shall be 2-inch threaded hubs. L-867 base cans shall be used in areas not subject to airplane traffic.

c. Base cans with two conduit connections shall have those connection points 180 degrees apart (for straight runs). Base cans with three 2-inch conduit connections shall have those connection points 90-90-180 degrees apart.

d. All base cans shall have both internal and external ground lug connections provided by the can manufacturer.

e. Anti-seize compound shall be applied to threaded connections for all base cans and other appropriate locations. Anti-seize compound shall be non-hazardous, contain no metals, and be compatible with stainless steel and nickel alloys. Suitable products include A.S.T. Industries Metal-Free 2000.

f. New stainless steel bolts shall be furnished for all base cans.

g. Blank covers provided for base cans shall be the product of a base can manufacturer and be 3/8" thick steel. Lids shall be hot dip galvanized and be furnished with a neoprene gasket.

h. All isolation transformers 30W and larger in basecans shall be provided with and installed on a plastic stand to minimize abrasion and immersion, and allow free drainage of the can. Stand shall be manufactured for this application. Stand shall be assembled and glued per manufacturer's recommendation prior to installation. 10/15W transformers are not required to be furnished with transformer stands as they will normally be suspended from the coiled cable in the can due to their light weight.

2.8 SPACERS AND EXTENSIONS

a. This item is included as an alternative means for bringing below grade cans up to grade. No specific utilization of this section is included in the design, and submittal for this item is required unless it is utilized.

b. Spacers and extensions for basecans shall be the product of an FAA approved basecan manufacturer and shall meet the requirements of FAA AC 150/5345-42 (latest edition) "Specification for Airport Light Base and Transformer Housings, Junction Boxes, and Accessories."

c. Spacers and extensions shall and shall match the bolt pattern, diameter, and rating of the application.

d. Spacers and extensions shall be Class I or Class II steel.

e. Anti-seize compound and new stainless steel bolts shall be provided for extensions as needed.

2.9 PRECISION APPROACH PATH INDICATOR (PAPI) LIGHTS.

a. The PAPI shall conform to the requirements of FAA Advisory Circular 150/ 5345-28 (latest revision), "Precision Approach Path Indicator Systems." The PAPI shall be ETL certified.

b. The PAPI shall be an L-881(L) (2-Box), Style A (voltage powered), Class 1 (operation to -35ºC). PAPI shall include photocell and automatic intensity adjustment.

c. Provide from the PAPI manufacturer: interconnection field splice kits as required, one Aiming Device (clinometer) – omit if light assemblies include built-in digital angle indication with 0.01 degree resolution, and two Instruction Manuals.

2.10 SERIES CUT-OUT (SCO) SWITCH.

a. Shall be a manufactured product designed for connection to the output of a constant current regulator (CCR) to facilitate maintenance or testing operations.

b. SCO Cabinet shall be 24" x 24" x 8" NEMA 1, steel, UL 508, hinge cover, handle closure, with HIGH VOLTAGE label.

2.11 SPARE PARTS

a. Spare equipment fixtures shall be provided to Airport Maintenance personnel, new in original packaging, in the quantities noted below. Light fixtures shall be furnished complete and ready for installation, including baseplate, lenses, prisms, bulbs, connector, etc., and shall be the same make and model as fixtures installed for the project.

1. L-824 Primary Splice kit (male and female connector) – 8 each
2. Primary splice heat shrink kit – 10 each
3. L-830 isolation transformers – 4% of each size used on the project, minimum of 1 each.
4. REIL Control Board Assembly – 1 each
5. Guidance Signs LED Sign light engine (tube/bar/circuit board) – 10 each, LED sign power supply – 10 each
6. Elevated Runway End Lights L-861E – (2) plug-n-play fixture head and stem with frangible fitting, (10) 45W quartz bulbs.
7. Elevated Taxiway Edge Lights L-861T(L) – (8) plug-n-play fixture head and stem with frangible fitting.
8. PAPI – (1) each Control Board Replacement Kit (Primary), Control Board Replacement Kit (Secondary), Input Power Board (Primary), Input Power Board (Secondary).

PART 3: CONSTRUCTION METHODS

3.1 GENERAL.

The Contractor shall furnish, install, and connect all equipment, equipment accessories, conduit, cables, wires, buses, grounds, and supports necessary to insure a complete and operable electrical distribution system for the airport lighting system as specified herein and shown in the plans.

3.2 PERMITS AND FEES.

The Contractor shall obtain and pay for all licenses, permits and inspections required by laws, ordinances and rules governing work specified herein. The Contractor shall arrange for inspection of work by the inspectors and shall give the inspectors all necessary assistance in their work of inspection.

3.3 BASE CAN INSTALLATION.

a. Details for the installation of base cans are shown on the drawings.

b. Excavate a hole only as large as necessary to install the base can with a minimum of backfill material. Provide 2-inches of compacted drain gravel in bottom of hole.

c. The base shall be supported in the excavation so that the top flange is within two degrees of level and at the elevation and location required to meet the requirements of light unit installation and alignment. Backfilling shall not cover exposed duct ends unless sealed.

d. PVC ducts shall be installed during the leveling process and in such a manner to assure proper alignment and attitude. Watertight coupling connections shall be made at the base can.

e. For base can installation in non-paved areas, grade material surrounding the base can away from the light base assuring positive drainage away from the light. The base can shall have its plywood protective cover reinstalled until time to install cables, transformers, and light units. Clean all debris from new or modified base cans prior to final closure.

3.4 COMMISSIONING AND TRAINING

a. Provide a vendor authorized service representative to perform equipment startup, testing, calibration, commissioning, and maintenance training of the following equipment. Work shall be performed per equipment manufacturer recommendations. As a minimum all controls shall be operated at least 3 times in each mode, and equipment shall be operated in each mode for at least 30 minutes continuously. Provide one week advance notice to Engineer of commissioning activities.
   1. REIL: L-849V(L), Runway End Identifier Lights
   2. Guidance Signs: L-858(L), refer to the drawings for legend and schedules.
   3. Runway End Lights: L-861E Runway End/Threshold Light, Elevated, Medium Intensity.
   4. Taxiway Edge Lights: L-861T(L) Taxiway Edge Light, Elevated, Omnidirectional, blue
   5. PAPI: L-881(L), Precision Approach Path Indicator
   6. SCO Switches

3.5 TESTING.

When the airfield is in service, the airfield lighting system shall be restored to service at the end of each work shift. The contractor shall check modified wiring for continuity, freedom from grounds, and perform a visual check that all lights and signs to be placed in service are working properly.

3.6 SALVAGE AND DISPOSAL.
The contractor shall give the Technical Representative 48 hours notice prior to disposal of equipment removed from service. The Technical Representative shall select those items that the airport elects to keep or salvage. The contractor shall be responsible for disposing of the remaining material at an off-site, licensed facility.

PART 4: METHOD OF MEASUREMENT

4.1 Demolish Airfield Equipment shall be measured by the lump sum for the complete demolition, including REILs, VASIs, edge/end lights, basecans, handholes, and all conduit and wire as detailed on the plans. This item shall include restoration of disturbed areas, and disposal of the material at a licensed off-site facility.

4.2 Isolation Transformers shall be incidental to the related equipment and no separate measurement or payment shall be made.

4.3 REIL Pair shall be measured by the unit (pair) installed, including excavation, encasement, backfill, basecan, concrete surround, interconnect cables and conduit, connections, testing, completed, and accepted. Wire/cable and conduit for the REIL power homerun shall be measured and paid separately per Items L-108 and L-110.

4.4 Guidance Signs shall be measured by the unit of each size installed, including excavation, encasement, backfill, basecan, isolation transformer, concrete surround/mow pad, isolation transformer, connections, testing, completed, and accepted. Separate measurement shall be made for the various types and sizes.

4.5 Runway End Lights shall be measured by the unit installed, including excavation, encasement, backfill, basecan, concrete surround, isolation transformer, cable, connections, testing, completed, and accepted.

4.6 Taxiway Edge Lights shall be measured by the unit installed, including excavation, encasement, backfill, basecan, concrete surround, isolation transformer, connections, testing, completed, and accepted. Cable and conduit for the taxiway light installation shall be measured and paid separately per Items L-108 and L-110.

4.7 Basecans shall be incidental to the related equipment and no separate measurement or payment shall be made. Basecans used as handholes or not associated with a particular piece of equipment shall be included in the L-100 Electrical Miscellaneous item.

4.8 PAPI Assembly shall be measured by lump sum for the complete assembly of all light units and controls installed, including excavation, encasement, backfill, basecan, concrete surround, interconnect cables and conduit, connections, testing, completed, and accepted. Wire/cable and conduit for the PAPI power homerun shall be measured and paid separately per Items L-108 and L-110.

4.9 SCO Cabinet complete assembly of cabinet and switches, connections, testing, completed, and accepted.

4.10 Spares shall be measured by the lump sum for the equipment listed in item 2.11 in this specification.

PART 5: BASIS OF PAYMENT

5.1 Payment will be made at the contract unit price for the items described above and as itemized below, completed and accepted. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item in accordance with the provisions and intent of the plans and specifications.

Payment will be made under:

Item A36	Demolish Airfield Equipment	– per lump sum
Item A37	REIL Pair	– per each
Item A38	Guidance Sign – Size 1, 2 panel	– per each
Item A39	Guidance Sign – Size 1, 3 panel	– per each
Item A40	Guidance Sign – Size 1, 4 panel	– per each
Item A41	Runway End Light	– per each
Item A42	Taxiway Edge Light	– per each
Item A43	PAPI Assembly	– per lump sum
Item A44	SCO Cabinet	– per lump sum
Item A45	Spares	– per lump sum

END OF ITEM L-125

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