F. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 12 inches or more in diameter and shall be trimmed of all branches to the heights indicated or directed.

G. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 12 inches in diameter shall be painted with an approved tree-wound paint. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work.

3.3 ROUGH GRADING

A. Identify required lines, levels, contours, and datum.

B. Identify known underground, aboveground, and aerial utilities. Stake and flag locations of utilities.

C. Notify utility companies to remove and relocate utilities.

D. Excavate topsoil and subsoil from areas to be further excavated, re-landscaped or re-graded.

E. Stockpile topsoil and subsoil in area designated on site. Remove excess topsoil and subsoil not being reused, from site. Install silt fence around perimeter of soil and subsoil stockpile areas. Stake and trench silt fence in place.

3.4 CLEAN UP

A. Remove debris, rock larger than 3” diameter and extracted plant life from site.

B. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

C. Burning tree, shrub, and other vegetation waste is permitted according to burning requirements and permitting of authorities having jurisdiction. Control such burning to produce the least smoke or air pollutants and minimum annoyance to surrounding properties. Burning of other waste and debris is prohibited.

D. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

3.5 GRUBBING

A. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in the construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

B. Use only hand methods or air spade for grubbing within protection zones.

C. Chip removed tree branches and stockpile in areas approved by Engineer.

3.6 CLEARING AND GRUBBING AREA

A. It is the intent of the work to minimize clearing and grubbing. The Engineer will designate the work area limits. Disturbed perennial plants and bushes outside the area shall be replaced by the Contractor under this section.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground not less than 90% relative compaction.

3.7 DISPOSAL OF MATERIALS

A. Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations shall be disposed of outside the limits of the project by the Contractor. Contractor shall be responsible for obtaining all permits required for site clearing, grubbing and off-site disposal.

B. Do not burn, bury, landfill, or leave materials to be cleared or grubbed on site.

C. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site.

D. Remove debris, junk, and trash from site.

E. Leave site in clean condition, ready for subsequent work.

F. Clean up spillage and wind-blown debris from public and private lands.

G. All material generated by this project must be disposed of at a permitted site when required. Contractor is solely responsible for obtaining all required local, state and/or federal permits required for disposal. Permitted facilities include construction and demolition debris sites, restricted use sites, and regional landfills.

3.8 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

END OF SECTION

SECTION 31 22 00 - GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

1. General exterior grading, cutting and filling, including grading for building area, paving, planting areas, banks and sloped hillsides. All excavation, fill and embankment shall be unclassified.
2. Perform borrow excavation and embankment construction as specified in the "GREENBOOK" as referenced in 1.1(B) below.
3. Spread topsoil over areas specified.
4. Protection of existing topographic features such as, but not limited to: utilities, site and off-site amenities, trees and landscape items to remain, etc.
5. Stripping and stockpiling Topsoil
6. Dewatering

B. RELATED SECTIONS:

1. Section 31 10 00 - Site Clearing.
2. Section 31 23 13 - Subgrade Preparation
3. Section 32 11 23 - Aggregate Base Course.
4. The following Sections of the "GREENBOOK" Standard Specifications for Public Works Construction, 2018 Edition, written and promulgated by Public Works Standards, Inc. and published by BNI Building News, 990 Park Center Drive, Suite E, Vista, CA 92081 shall be included in this specification as if fully written:
   a. Section 200 - 1: Rock Products
   b. Section 300 - Earthwork
      1) Section 300-1: Clearing and Grubbing
      2) Section 300-2: Unclassified Excavation
      3) Section 300-3: Structure Excavation and Backfill
      4) Section 300-4: Unclassified Fill
      5) Section 300-5: Borrow Excavation
      6) Section 300-6: Earthwork for Debris Dams and Basins
      7) Section 300-7: Earthwork for Channels
      8) Section 300-8: Geotextiles for Drainage

1.2 PROJECT REQUIREMENTS

A. General:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.
4. Before grading, contact Underground Service Alert of Southern California (USASC) for information on public buried utilities and pipelines. Retain the services of an underground utility locator for on-site utilities.

1.3 GEOTECHNICAL CONSULTANT AND TESTING

A. The Owner has retained the services of a qualified geotechnical consultant to perform specified maximum density and in-place density tests.

B. Responsibilities of the geotechnical consultant will include:

1. Sampling, testing and approval of excavated materials used for embankment construction.
2. Observation of placement and testing of materials during placement to determine that specified compaction and moisture requirements are met.
3. Preparing reports that summarize the observations and materials testing and submitting to Engineer, Owner and Contractor.

1.4 DESCRIPTION OF WORK

A. Protection: includes, but is not limited to, sheeting, shoring and bracing, earth stabilization, and protection of existing utilities and structures necessary to prevent damage to the work, property, life and limb, due to earth moving operations.

B. Stripping and Respreading Topsoil: includes stripping, stock piling, and spreading of the depth of topsoil indicated on the Construction Drawings.

C. Unclassified Excavation, Fill and Embankment: includes excavation, storing, and rehandling of all normal earth materials, such as loam, silt, gumbo, peat, clay, soft shale, sand, gravel and fragmentary rock or boulders, or any other material encountered, regardless of its nature, which may be handled in a manner similar to normal earth materials from existing ground surface to subgrade for pavement or to finish grade outside the paved areas. It also includes:

1. Site preparation.
2. Removal and disposal of excess excavated material.
3. Loading and hauling of the material from the area being excavated to the

embankment.

4. The placing and proper compaction of excavated material in an embankment within the Project limits of this Contract.
5. Disking and aeration of wet soil in order to remove moisture from the material.
6. Furnishing and applying water as required to obtain proper moisture content and compaction and control dust.
7. Rework and retesting of areas and materials where failing tests occur.
8. The finish grading of earth surfaces.
9. Dewatering
   a. Dewatering – This work includes the removal of groundwater from the excavation utilizing a well system, portable pumps, or some other means appropriate to maintain a reasonably dry excavation.

1.5 SUBMITTALS

A. If the Contractor is to provide a borrow site and the Contractor is not the owner of the borrow site, prior to commencing work on the borrow site, the Contractor shall be responsible to obtain written authorization from the owner of the borrow site, to utilize the area as a borrow site and provide such authorization to the Engineer. Upon completion of the restoration of the borrow site, the Contractor shall also be responsible to obtain written acceptance from the owner of the borrow site regarding its restoration, and provide a copy of such acceptance to the Engineer.

B. Submit samples and test results as set forth in the Contract Documents.

C. Submit certificate of compliance indicating the materials incorporated into the work comply with the Contract Documents.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store cleared, grubbed, and excavated material in locations which will minimize the interference with operations, minimize environmental damage, facilitate proper drainage, and protect adjacent areas from flooding, runoff and sediment disposition.

1.7 SCHEDULING AND CONFLICTS

A. Schedule work to minimize disruption of public streets and facilities.

B. Coordinate work with the local municipal Public Works Department.

1.8 SPECIAL REQUIREMENTS

A. Use of explosives is forbidden unless provided for in the Contract Document Special Provisions.

B. All work and materials incorporated into this Project shall conform to all applicable local, state, and federal requirements.

C. During the progress of work, the Contractor shall conduct his operation and maintain the area of his activities so as to minimize the creation and dispersion of dust per Section 31 25 00.

1.9 JOB CONDITIONS

A. Elevations shown for existing work and ground are reasonably correct, but are not guaranteed to be absolutely accurate. Contractor shall notify Engineer of any discrepancy between the existing and/or proposed elevations prior to proceeding with work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials shall conform to requirements specified in this and related sections.

2.2 EMBANKMENT CONSTRUCTION

NOT APPLICABLE.

2.3 BORROW

A. Material incorporated in the Project as a part of this item shall meet the requirements for suitable material for use in embankment construction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain installed stakes until their removal is required for the Work. Provide replacement grade or location stakes lost or disturbed.

B. Install grade stakes and compare to indicated grades. If discrepancies are found between existing grades and grades indicated on Drawings, do not proceed until discrepancies are resolved.

C. Prior to all excavating, Contractor shall become thoroughly familiar with the site and all existing and proposed site conditions.

D. Nothing in this Specification shall be deemed to allow the use of protective systems less effective than those required by the Occupational Safety and Health Administration (OSHA) and other applicable code requirements.

E. The Contractor shall keep Project free from drainage ponding due to construction operations.

F. High Ground Water Conditions (when present)

1. Prior to site grading and any excavation, an effective means of controlling groundwater shall be established to “predrain” the site and minimize disturbance of the bearing soils.
2. Use a series of ditches, French drains, and/or drain lines to lower the groundwater level to at least 2 feet below the excavation depth. This system can be incorporated into the pavement underdrain system.
3. Avoid operating heavy equipment directly on soft saturated soils; consider performing earthwork with track-mounted construction equipment to minimize subgrade disturbance.

3.2 ROUGH AND FINE GRADING

A. Rough grade area sufficiently high to require cutting by fine grading:

1. Grade area for bituminous surfacing and other paving to the indicated grades, equal to the section of the indicated base and pavement.

B. Slope banks to required finish grades as cut progresses or leave cuts full and finish grade by mechanical equipment to provide grades and soil densities indicated on the Drawings.

C. Rough grade, fill and compact banks beyond indicated finish grades. Finish grade banks and slopes to indicated grades and specified soil densities.

D. Grade Only Areas: In areas not indicated to receive pavement, rough grade to approximate finish grades and then scarify, moisten and roll to obtain required density and indicated finish grades.

E. Tolerances: Finish grades shall be within the following tolerances above or below grades indicated. Provide an average grade as indicated:

1. Unpaved areas near buildings, parking areas and sidewalks: +0.10 ft.
2. Unpaved areas away from buildings, parking areas and sidewalks: +0.25 ft.
3. Grading surface of fill under building slab: +0.04 ft to –0.10 ft.

F. Base or Subgrade:

1. After subgrade has been constructed to approximate required grades, scarify to a

depth of at least 6 inches:

a. After scarifying, process loosened material to a finely divided condition and adjust moisture content to optimum condition by addition of water, addition and blending of dry suitable material, or by drying of existing material.
b. Subgrade material shall be compacted by tamping, sheepsfoot rollers or pneumatic tire rollers. Required relative compaction shall be 90 percent minimum for the top 12 inches below subgrade.
c. Install base course in accordance with Section 32 11 23 – Aggregate Base Course.

2. Tolerance of completed grades of base or subgrade shall not vary more than 0.03 inch per foot from grades indicated. Provide an average grade as indicated.

3.3 SHORING AND BRACING

A. Provide shoring as necessary to properly and safely support earth sides of excavations, and existing curbs, sidewalks, gutter, drives and stairs, against movement and collapse.

B. Design and Calculations: Provide in accordance with requirement of CalOSHA.

C. Remove shoring upon completion of the Work of this section or when no longer needed unless required otherwise by authorities having jurisdiction.

D. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and crossbraces, in good serviceable condition.

E. Establish requirements for trench shoring and bracing to comply with local codes, Construction Manager work rules and authorities having jurisdiction.

A. Maintain shoring and bracing in excavations regardless of the time period excavations will be open. Carry down shoring and bracing as excavation progresses.

3.4 EXCESS MATERIAL DISPOSAL

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

B. Contractor shall be solely responsible for obtaining all required permits for off-site disposal of site materials.

3.5 PROTECTION

A. Protect the Work of this section until Substantial Completion.

B. Contractor shall provide all necessary sheeting and shoring including all labor, material, equipment and tools required or as necessary to maintain the excavation in a condition to provide safe working conditions, to permit the safe and efficient installation of all items of the work, and to protect adjacent property. Contractor shall be held liable for any damage which may result to property from excavation or construction operations. Sheet piling and timbers in excavations shall be withdrawn in a manner so as to prevent subsequent settlement of structures.

C. Provide the necessary traffic control protection according to Section 01 55 26 to prevent accidents, to avoid all hazards and to protect the public, the work and property at all times.

D. The Contractor shall be responsible for damages to any party whatsoever by reason of the Contractor's neglect in providing proper safeguards to prevent damage to property, life and limb.

E. Protect structures, utilities, sidewalks, pavements, and other facilities from damage due to settlement, lateral movement, undermining, washout and other hazards created by earth operations.

3.6 BORROW EXCAVATION

A. Replace zones of unstable material encountered with suitable material.

B. Unstable material and excess excavated material shall be transferred off site to disposal areas designated by the Owner.

C. Borrow excavation shall be conducted in accordance with Section 300-5 of the "GREENBOOK" Specifications.

3.7 EMBANKMENT CONSTRUCTION
NOT APPLICABLE.

3.8 MATERIAL TESTS

A. Moisture-density laboratory tests: Minimum of one test on each type of soil to be used in embankment construction; conform to ASTM D698 (Standard Proctor). Perform tests prior to placement of embankment materials.

B. In-place density tests for embankments: Perform tests on embankments for successive 8" layers conforming to ASTM D2922 and ASTM D3017.

3.9 FINISH GRADING

A. Finish grade and borrow to grades shown on the Drawings.

B. Finish grade to neat appearance and to provide positive drainage.

C. Handwork with tampers and other hand tools may be required to achieve neat appearance around structures.

D. All earth surfaces, except those requiring aggregate or riprap, shall have topsoil placed to the finished grade lines as shown on Drawings and seeded. The depth of topsoil shall be as specified on the Construction Drawings.

3.10 OPERATIONS

A. Water must be used as a controlling agent for dust control.

B. Regulations as set forth by OSHA and appropriate state agencies shall govern.

3.11 POND BOTTOM

A. Uniformity

1. Finished elevations shall not be more than 3 inches from the average elevation of the bottom. Shallow or feathering fringe areas usually result in locally unsatisfactory conditions.

B. Vegetation

1. The bottom shall be cleared of vegetation and debris. Organic material thus removed shall not be used in the dike core construction. However, suitable topsoil relatively free of debris may be used as cover material on the outer slopes of the embankment.

C. Soil

1. Soil used in constructing the pond bottom (not including the seal) shall be relativity incompressible and tight. Porous topsoil shall be removed. Porous areas, such as gravel or sandy pockets, shall be removed and replaced with well compacted clay. The entire bottom shall be compacted clay. The entire bottom shall be compacted at or up to 4% above the optimum water content to at least 90% Standard Proctor density.

D. Seal

1. When specified on the Construction Drawings, the pond bottom and embankments shall be sealed such that seepage loss through the seal is low as possible. Seals consisting of soils, bentonite or synthetic liners may be used, provided that the permeability, durability and integrity of the proposed material is demonstrated for anticipated conditions. The results of the testing program that substantiates the adequacy of the proposed seal shall be incorporated into or

accompany the engineering report. Standard ASTM procedures or similar accepted testing methods shall be used for all tests.

a. A seal consisting of soil materials shall have a thickness of at least 24 inches and a permeability of less than 1x10(-7) cm per second. Provision shall be made in the specifications for demonstrating and permeability of the seal after completion of construction.
b. For a seal that consists of a synthetic liner, seepage loss through the line shall not exceed a quantity equivalent to seepage loss through a soil seal as described above.

E. Prefilling

1. Prefilling the pond after completion of testing is recommended in order to protect the seal from weed growth, to prevent drying and cracking and to reduce odor during initial operation. The pond dikes must be completely prepared as described in subsection (d)(1)(F). Synthetic liners shall be protected from damage during installation and filling.

3.12 FINISH ELEVATIONS AND LINES

A. Secure the services of a surveyor licensed in the State of California for setting and establishing the elevations, line and layout of the work. Take care to preserve all data and monuments set by the surveyor, and if displaced or lost, immediately replace them to the approval of the Engineer at no additional cost.

3.13 UNCLASSIFIED EXCAVATION

A. Do not start unclassified excavation suitable temporary erosion and sediment control measures are in place as set forth in Section 31 25 00.

B. Excavate the area to the elevations and cross sections as indicated in the Contract Documents.

C. When excavation has reached the required subgrade elevations, notify the Engineer who will make an inspection of conditions.

D. If excess excavated material exists, it shall be disposed of legally off-site in accordance with the Contract Documents.

E. All material other than non-organic firm solid earth, sand or gravel shall be removed from the excavation.

F. Excavation for all footings, foundation walls, pits, etc. shall be large enough to provide adequate clearance for the proper execution for the work within them.

G. Excavations scheduled to extend below groundwater shall not be started until the area has been dewatered.

H. No footings or slabs shall bear on soil within two feet of existing grade. Where subgrade is within two feet of existing grade, remove soils to two feet below existing grade and backfill with compacted fill.

I. When excavations reach subgrade elevations as shown on the Drawings, or as specified herein, the Engineer will observe the bottom material. Where, in the opinion of the Engineer, unsuitable foundation material is found at the level of the subgrade, original material below the excavation necessary for construction according to grades shown or specified, shall be removed and replaced with material and placing methods as specified under compacted fill.

J. Excavations that are undercut beneath the foundation shall extend beyond the perimeter of the foundation one-foot plus a distance at least equal to the depth of undercut below footing grade.

K. Contractor shall backfill and compact all over-excavated areas not required to complete the work at Contractor's expense.

3.14 COLD WEATHER PROTECTION

A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 deg. F. (2 deg. C.). Material shall not be placed on frozen ground.

3.15 DEWATERING

A. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding the project site and surrounding area.

B. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and

C. discharge lines, and other dewatering system components necessary to convey water away from excavations.

D. Convey water removed from excavations and rainwater to collecting or run-off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for structure. Do not use trench excavations as temporary drainage ditches.

E. Dewater to at least two feet below the top of subgrade elevation.

3.16 UTILITIES

A. Locate existing underground utilities in areas of work before starting excavations.

B. Provide adequate means of protecting utilities that remain in place during earthwork operations.

C. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility company immediately for directions.

D. Cooperate with Owner and utility companies in keeping respective services and facilities in operation and repair any damaged utilities to satisfaction of utility company.

E. Do not interrupt existing serving facilities occupied and used by Owner or others, except when permitted in writing by Owner.

F. Accurately locate and record abandoned and active utility lines rerouted or extended on Project record drawings.

G. In case water, gas pipes, conduits, or other utilities are broken in the prosecution of the work, stop work and give immediate notice to the proper authorities. Contractor shall be responsible for any damage to persons or property caused by such breaks. Failure to give prompt notice to the authorities shall make the Contractor responsible for any needless loss of water, gas, energy, or for interruption of services.

3.17 CLEAN-UP

A. Upon completion of the work of this Section, place in stockpile areas all excess excavated material, and remove from the site all rubbish, trash and debris resulting from operations. Leave the site in a neat and orderly condition.

END OF SECTION

SECTION 31 23 13 - SUBGRADE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Subgrade Preparation.
   2. Subgrade Stabilization
   3. Granular Subbase.
   4. Special Backfill.
   5. Granular and Earth Shoulder Preparation.

B. Related Sections
   1. Section 33 10 00 - Site Clearing
   2. Section 31 22 00 - Grading
   3. Section 32 11 23 - Aggregate Base Courses
   4. Section 32 16 00 - Curbs, Gutters, Sidewalks and Driveways
   5. The following Sections of the "GREENBOOK" Standard Specifications for Public Works Construction, 2018 Edition, written and promulgated by Public Works Standards, Inc. and published by BNI Building News, 990 Park Center Drive, Suite E, Vista, CA 92081 shall be included in this specification as if fully written:
      a. Section 200 - 1: Rock Products
      b. Section 300 - Earthwork
      c. Section 301 - Subgrade Preparation, Treated Materials and Placement of Base Materials.
         1) Section 301-1: Subgrade Preparation
         2) Section 301-2: Untreated Base

1.2 DESCRIPTION OF WORK

A. Subgrade Preparation – includes the shaping and consolidation of a prescribed portion of a roadbed, parking area and/or paved area in preparation for the placement of granular subbase.

B. Subgrade Stabilization – includes the removal and disposal of unsuitable or unstable material that is not appropriate to place subbase on and backfill with suitable backfill or macadam stone base material. Geotextile fabrics, as required per the Contract Drawings, are also included in this section.

C. Granular Subbase - includes the furnishing, placing, shaping and compaction of granular subbase in preparation for PCC or ACC pavement.

D. Special Backfill – includes furnishing, placing, shaping and compaction of special backfill in preparation for pavement base course.

E. Granular and Earth Shoulder Preparation – consists of blading over the foreslope both the soil excavated from the trench and any material of the shoulder lying above the proposed, finished shoulder line, and hauling offsite, as required. Work shall also include the placement of granular shoulder material, as required.

1.3 SUBMITTALS

A. Submit certification of compliance and/or samples indicating the materials incorporated into the Work comply with the Contract Documents.

B. The substitution of materials is allowed as set forth in the General Conditions.

1.4 SCHEDULING AND CONFLICTS

A. Schedule Work to minimize disruption of public streets and facilities.

1.5 SPECIAL REQUIREMENTS

A. All Work and materials incorporated into this Project shall conform to all applicable local, state, and federal requirements.

PART 2 - PRODUCTS

2.1 SUBGRADE STABILIZATION

A. All backfill materials utilized for the backfill of excavation of unsuitable or unstable soil shall meet the requirements for suitable soil as set forth in Section 31 22 00.

B. Geotextile Stabilization Fabric:
1. All engineering fabric (geogrid) incorporated into this item shall have properties as set forth in the “GREENBOOK” Specification Section 213-1 “Engineering Geosynthetics”.
2. All engineering fabric (geotextile) incorporated into this item shall have properties as indicated in the GREENBOOK” Specification Section 213-1 “Engineering Geosynthetics”.

2.2 GRANULAR SUBBASE

A. The granular subbase material shall meet the requirements of the following "GREENBOOK" Specifications:
   1. Section 200-2: Untreated Base Materials
   2. Reclaimed asphalt shall not be allowed.

B. The granular subbase material for use with geogrid applications shall meet the requirements of the Manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

A. Remove all deleterious materials such as topsoil, vegetation, or loose, soft, frozen, or otherwise unsuitable materials. The actual stripping depth shall be evaluated by qualified geotechnical personnel.

B. The Contractor shall keep Project Site free from drainage ponding due to construction operations.

C. High Ground Water Conditions (when present)
   1. Prior to site grading and any excavation, an effective means of controlling groundwater shall be established to "predrain" the site and minimize disturbance of the bearing soils.
   2. Use a series of ditches, french drains, and/or drain lines to lower the groundwater level to at least 2 feet below the excavation depth. This system can be incorporated into the pavement underdrain system.
   3. Heavy equipment traffic directly on soft saturated soils should be avoided. Consideration should be given to performing earthwork with track-mounted construction equipment which helps minimize subgrade disturbance.

D. Subgrade compaction shall be Type A unless otherwise specified. Type A compaction refers to compaction requiring a minimum of one rolling per inch depth of each lift and a maximum of 8 inch lifts, and it is further required that the roller continue operation until it is supported on its feet, or the equivalent.

3.2 SUBGRADE PREPARATION

A. Preparation of subgrade shall not commence prior to the completion of any trenching operations under the area to be paved except as specified in Section 33 41 00. If the subdrains are installed prior to subgrade preparation, the Contractor shall be responsible to protect the porous material from contamination with the subgrade material.

B. The subgrade shall be constructed to have uniform stability for at least 12 inches below top of subgrade and for a width at least equal to that of the proposed pavement plus 2 feet on each side. It shall be brought to an elevation and cross section as set forth in the Contract Documents and such that, after being rolled, the surface shall be at the required elevation. If subdrains are installed prior to subgrade preparation, the area 2 feet outside the paved area does not require compaction in addition to consolidation of the porous material in the subdrain trench.

C. Compaction of soils with greater than 6 percent fines shall be accomplished with an impact device.

D. Compaction of soils with less than or equal to 6 percent fines shall be accomplished with vibratory devices.

E. Subgrade Compaction:
   1. After rough grade has been established and prior to placement of any fill, the exposed subgrade should be proofrolled in the presence of the Engineer's representative. Proofroll subgrade with minimum 20 ton loaded tandem truck to determine uniformity and stability of subgrade.
   2. In cut sections, disk, scarify, moisture condition and recompact the top 12 inches of subgrade with Type A compaction.
      a. If equipment is not sized to perform required compaction at minus 12 inches, then excavate top 6 inches of subgrade, then scarify, moisture condition, and recompact next 6 inches of subgrade with moisture and density control. Then replace, pulverize, moisture condition, and compact top 6 inches of subgrade.
      b. The above requirement also applies for the top 12 inches of embankments.
      c. The upper 12 inches of subgrade shall consist of a low-plasticity cohesive soil, or granular material. If fat clay exists at the subgrade elevation, lime or Class C fly ash could be incorporated into the soil to reduce its plasticity. The underlying fat clay should not be allowed to desiccate; the soil should be maintained at 0 to +4 percent of the soils optimum moisture value.
   3. Compact soil to 95 percent of the material's maximum standard Proctor dry density with moisture content between –2 to +3 percent of the soil's optimum moisture content, unless specified otherwise on the Construction Documents.
   4. Unsuitable areas observed shall be improved by compaction or by undercutting and replacing with suitable compacted fill.
   5. Contractor shall repeat scarification, recompaction, and testing as many times as needed to obtain specified density.

F. Remove large stones or rubble (i.e., concrete) over 3 inches in size from within 2 feet of the finished subgrade elevation.

G. Unstable Material: If soft, yielding, or pumping areas are located, improve by scarifying, moisture conditioning and recompaction or remove unstable materials and replace with suitable materials and compact as specified.

H. Following the trenching operations, the Contractor shall scarify, thoroughly mix, and recompact the materials present in the upper 12 inches of the subgrade for the full width of the subgrade area to produce a uniform condition. The compaction shall be to 95 percent of maximum standard proctor dry density with moisture content between –2 and +3 percent of soil's optimum moisture content.

1. The Contractor shall determine if moisture content of the material is excessive or suitable for satisfactory compaction. The Contractor may elect to start rolling operations immediately after the smoothing operation, or may elect to delay rolling operations, and instead, aerate the material in preparation for rolling. Aeration and compaction operations shall proceed in an orderly fashion without unreasonable and unnecessary delay. Rolling operations made prior to any aeration operations for a lift will not be counted as any of the required coverages.
2. Should the material be dry to the extent that it is likely to be unsatisfactorily compacted, the Contractor may moisten the material, or the Engineer may order the material to be moistened uniformly, before it is compacted. Authorization may be given for the use of water in the final finishing of the roadbed.

I. Following completion of subgrade scarification and compaction, subgrade shall be proof-rolled in the presence of the Engineer. Proof-roll subgrade with a minimum 20-ton loaded tandem truck to determine uniformity and stability of subgrade.

J. Subgrade Maintenance:

1. Maintain subgrade prior to and during paving operations.
2. Care should be taken to avoid saturation or desiccation of the subgrade prior to construction of pavement. If this occurs, the material shall be removed, or scarified, moisture conditioned and recompacted.
3. Pavements shall be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavement could saturate the subgrade and contribute to premature pavement deterioration.

K. If rutting or any other damage occurs to the subgrade for any reason, the Contractor shall immediately repair the subgrade. Such repair will include, if necessary, scarifying, aerating, and recompacting the subgrade.

3.3 SUBGRADE STABILIZATION

A. Prior to commencing with the removal of unsuitable or unstable material, the Contractor shall be responsible to notify the Engineer. The Engineer will review the conditions and, if appropriate, shall authorize the Work to proceed.

B. The Engineer shall mark the limits of the excavation and may observe the Work.

C. If the excavation is backfilled with suitable soil, the upper 8 inches shall be compacted as set forth in subgrade preparation. Any material below that shall be compacted in accordance with the requirements for the construction of embankment.

D. If the excavation is backfilled with macadam stone base material, the material shall be consolidated as it is placed. Required depth for subgrade stabilization shall be established by the Engineer.
   1. Remove soft, unstable soil to a desired depth.
   2. Backfill area with material meeting the requirements of Section 2.01.

E. Subgrade areas from which unstable native material has been excavated may be lined with geotextile prior to placement of macadam stone for subgrade stabilization. Engineer shall determine the need for geotextile use.

F. The following procedure for subgrade stabilization may be utilized, subject to the approval of the Engineer.
   1. Excavate unstable native subgrade to depth ordered by the Engineer, but not less than 12 inches.
   2. Place granular subbase over excavated subgrade and in-place geogrid in accordance with manufacturer's instructions.

G. Contract Documents or the Engineer shall identify which of the above-described stabilization procedures is approved for a given project.

3.4 SOIL REINFORCEMENT FABRIC/GEOGRID

A. General
   1. Remove and replace fabric areas damaged during construction. Lap or sew replaced fabric, as specified for the class of fabric used.
   2. Install geotextiles in accordance with manufacturer's recommendations.
   3. Do not run vehicles directly on engineering fabrics. Rubber tired vehicles shall not run on rock placed over soil reinforcement fabric.

B. Soil Reinforcement Geogrid
   1. See geotechnical report instructions for geogrid.

END OF SECTION

SECTION 31 2319 – EXCAVATION AND FILL FOR STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating, backfill, and compacting for structures.
2. Fill materials.

B. Related Requirements:
1. Section 31 1000 - Site Clearing.
2. Section 31 2200 - Grading.

1.2 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.3 SUBMITTALS

A. Imported soils: A geotechnical engineer, retained by the Owner as an Owner Consultant, shall obtain initial product Sample for testing in accordance with the terms of Article 3.05 of this section.

B. Shoring calculations as required in Article 3.03 of this section

1.4 QUALITY ASSURANCE

A. Comply with the Standard Specifications for Public Works Construction, current edition, except as modified herein.

B. Sampling, testing, and certification of imported and/or exported soils shall be performed.

1.5 PROJECT CONDITIONS

A. Information on Drawings or in soil investigation report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

B. A copy of the foundation investigation and soils report is available for examination at the Architect's office during regular office hours of Architect.

PART 2 - PRODUCTS

2.1 FILL AND BACKFILL MATERIALS

A. Fill and backfill material shall be a granular material previously removed from excavation or imported fill material, free of clods and stones larger than 3 inches,

foreign materials, vegetable growths, sod, expansive soils, rubbish, and debris. Material shall conform to these specified requirements and related sections.

B. Fill material exhibiting a wide variation in consistency and moisture content shall be blended and aerated to stabilize and upgrade the material.

C. Imported Fill Material:

1. Provide suitable materials obtained from Project site excavations for earthwork and fill materials. If excavated materials are not of suitable quality or sufficient quantity, import additional materials as necessary.
2. Imported fill shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing 200 mesh sieve. Material shall have a coefficient of expansion of not more than 2 percent from air dry to optimum moisture content and not more than 6 percent from air dry to saturation. Imported material shall be clean and free of rubbish, debris, and toxic or hazardous contaminants. Adobe or clay soils are not permitted.

D. Other Fill Materials: Brick rubble and broken concrete originating from the Project site may be legally disposed of off the Project site, or incorporated in fill, if reviewed by a geotechnical engineer, retained by the Owner as an Owner Consultant. Unless otherwise indicated, no such material shall be imported from outside the Project site.

E. Permeable Backfill:

1. Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations of these materials conforming to the following gradations:

Sieve Size:	Percentage Passing:
3/4 inch (19mm)	100
3/8 inch (10mm)	80 to 100
No. 100	0 to 8
No. 200	0 to 3

2. Those portions of fill material passing a No. 4 sieve shall provide a sand equivalent of at least 60.
3. Provided backing for weep-holes shall consist of two cubic feet of aggregate in burlap sacks, securely tied. Aggregate shall conform to requirements for No. 3 concrete aggregate as specified in subsection 200-1.4 of the Standard Specifications for Public Works Construction.
4. Permeable Backfill Alternate Materials: Instead of the materials specified for retaining structures backfill, a drainage matting system Miradrain by Mirafi, Inc., or equal, may be provided if reviewed by the Architect.

PART 3 - EXECUTION

3.1 SITE PREPARATION

A. Clear the Project site as required in Section 31 1000 - Site Clearing.

3.2 PROTECTION

A. Protect and guard excavations against danger to life, limb, and property as required by, but not limited to, Cal-OSHA regulations.

B. Protect adjacent existing improvements including landscaping against damage.

C. Shore, crib, or lag excavations and earthen banks as necessary to prevent caving-in, erosion or gullying of sides.

D. Divert or de-water excavations until concrete is placed, forms are removed, and backfilling is complete.

3.3 SHORING

A. Provide shoring as necessary to support earth sides of excavations, curbs, sidewalks, gutter, drives and stairs, properly and safely against movement and collapse.

B. Design and Calculations: Provide in accordance with requirement of Cal-OHSA. Remove shoring upon completion of Work, or when no longer needed.

3.4 EXCAVATION

A. Form sides of footings, pads, grade beams, and slab foundations, unless otherwise indicated. Provide excavations of sufficient size to permit installation and removal of forms and other Work as required.

B. Machine-drill excavation for round footings to size and depth indicated. Provide a collar or casing, or other adequate protection, to exclude dirt and debris. Protect excavations with plank covers until concrete is placed.

C. Provide excavation bottoms level and free from loose material. Excavate to indicated or required elevations of undisturbed earth.

D. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. If soil becomes soft, soggy, or saturated, excavate to firm undisturbed soil and fill as required. Slope adjacent grades away from excavations to minimize entry of water.

E. Calculate excavation quantities based on elevations or depths indicated on Drawings.

F. Special preparation of bottom of excavated planes areas: Excavate areas designated on Drawings as bottom of excavated planes (B.E.P.), by excavating and filling to indicated grades and elevations.

3.5 IMPORT/EXPORT OF MATERIALS

A. Provide fill materials as specified in Part 2- Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials, as necessary.

B. Imported fill materials shall be sampled by the geotechnical engineer, retained by the Owner as an Owner Consultant, for compliance with the requirements of Part 2 of this section.

C. The geotechnical engineer, retained by the Owner as an Owner Consultant, shall submit all samples to a DSA approved independent testing laboratory for testing.

D. Initial sampling shall be performed by a geotechnical engineer, retained by the Owner as an Owner Consultant, before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The geotechnical engineer, retained by the Owner as an Owner Consultant, shall obtain both the initial sample and additional samples from the identified site, and shall submit samples to the approved independent testing laboratory for testing.

E. The geotechnical engineer, retained by the Owner as an Owner Consultant, shall perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1,000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1,000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.

F. The independent approved testing laboratory shall perform the required tests and report results of tests noting if the tested material passed or failed such tests and shall furnish copies to the Project Inspector, Architect, OAR, Contractor, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, and CBC. Upon completion of the Work of this section, the independent testing laboratory and geotechnical engineer shall submit a verified report to the Project Inspector as required by CBC.

G. Bills of lading or equivalent documentation will be submitted to the Project Inspector daily.

H. Upon completion of import operations, provide the OAR a certification statement attesting that all imported material has been obtained from the identified source site.

3.6 BACKFILLING

A. After concrete has been placed, forms removed and concrete Work inspected, backfill excavations to indicated or required grades. Backfill simultaneously on each side of walls or grade beams. Remove rubbish, debris, and other waste materials from excavations before placing backfill.

B. Before installing any backfill, adequately cure concrete, and provide bracing to stabilize structures. Protect waterproofing or dampproofing against damage during backfilling operations with required protection board. Remove bracing as backfill operation progresses.

C. Do not furnish or install expansive soils for below grade building walls.

D. Install each layer of material in a not to exceed thickness of 6 inches, unless otherwise required.

E. Rigidly control the amount of water to be installed to provide optimum moisture content for type of fill material furnished. Do not over-saturate or compact by flooding or jetting.

F. Install wall backfill before installing railings and fences on walls.

G. Impervious backfill materials shall be installed in layers along with and by the same methods specified for structure backfill. Impervious backfill materials shall be at the approximate grade and elevation and where exposed to erosion, shall be covered with at least a 12-inch layer of fill material as reviewed by the geotechnical engineer, retained by the Owner as an Owner Consultant.

H. Install weep hole drainage at the backside of walls so the backing completely covers the weep holes, is horizontally centered and extends at least 12 inches above the bottom of the weep opening. Provide an 8-inch square section of 1/4 inch galvanized or aluminum screen, with a minimum wire diameter of 0.03 inch, and install at the backside of each weep hole before installing the backfill material.

I. Where a reviewed drainage matting system is provided instead of permeable backfill for retaining structures, install in accordance with the manufacturer recommendations.

3.7 COMPACTING

A. Compact each layer of fill material by tamping, sheepsfoot rollers or pneumatic-tired rollers, to such extent as to provide specified relative compaction. At inaccessible locations, compact to specified requirements with hand-held, operated and directed compaction equipment.

B. Unless otherwise indicated, compact each layer of fill material to a relative compaction of at least 90 percent.

C. Do not compact by flooding or jetting.

D. When fill materials, or a combination of fill materials, are encountered or provided which develop densely packed surfaces because of installation or compacting operations, scarify each layer of compacted fill before installing the next succeeding layer.

3.8 INSPECTION AND TESTING

A. The geotechnical engineer, retained by the Owner as an Owner Consultant, will inspect and test excavations, sample material quality for testing as set required in Part 2, and observe installation and compaction of fill materials.

B. The geotechnical engineer, retained by the Owner as an Owner Consultant, will sample imported fill materials from their designated source and submit samples to the independent approved testing laboratory before delivery to the Project site.

C. Installation of backfill shall be observed by the geotechnical engineer, retained by the Owner as an Owner Consultant.

D. The geotechnical engineer, retained by the Owner as an Owner Consultant, will inspect and test excavation Work before the installation of fill and other materials.

E. Compaction: Test compaction in accordance with ASTM D1557, Method C.

F. The Project Inspector will inspect foundation excavations when completed and ready for forms, after forms are in place and before first placement of concrete.

3.9 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.10 CLEANING

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION 312319

SECTION 32 12 13 - PREPARATORY COATS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Included in this section is the preparation of the gravel surface, prime and treating the bituminous surfacing with tack coat.

1.2 RELATED SECTIONS

A. Section 31 23 13 - Subgrade Preparation

B. Section 32 11 23 - Aggregate Base Course

1.3 REFERENCES

A. The following Sections of the "GreenBook" Standard Specifications for Public Works Construction, 2018 Edition, written and promulgated by Public Works Standards, Inc. and published by BNi Building News, 990 Park Center Drive, Suite E, Vista, CA 92081 shall be included in this specification as if fully written:
   1. Section 302-5 - Asphalt Concrete Pavement
   2. Section 302-5.3 - Prime Coat
   3. Section 302-5.4 - Tack Coat
   4. Section 302-7 - Pavement Fabric

1.4 QUALITY ASSURANCE

A. Source Quality Control:
   1. Prime - MC-70: AASHTO M82.
   2. Tack:
      a. SS-1h: AASHTO M140.
      b. CSS-1h: AASHTO M208.
   3. SS-1h Flush Seal: AASHTO M140.

1.5 FIELD CONDITIONS

A. Weather and Seasonal Requirements:
   1. Application shall be made only during daylight hours, when the wind does not adversely affect the spraying operation and when the following conditions are met:

2. Tack Coat: The application of a tack coat will be permitted only:
   a. When air and surface temperature on the project are both at least 35° F. in the shade.
   b. When conditions are dry, except emulsified asphalt may be applied when the surface is slightly damp.
   c. Prime Coat: The application of a prime coat will be permitted only:
      1) When the air and surface temperatures on the project are both at least 60° F. in the shade.
      2) When conditions are dry.

PART 2 - PRODUCTS

2.1 SAND FOR FLUSH SEAL

A. Prime, Tack, and Flush Seal:
   1. Prime - MC-70: AASHTO M82
   2. Tack:
      a. SS-1h: AASHTO M140
      b. CSS-1h: AASHTO M208

PART 3 - EXECUTION

3.1 EQUIPMENT

A. The following minimum equipment shall be furnished by the Contractor.
   1. Broom: A rotary power broom.
   2. Heating Equipment: Equipment for heating asphalt material in or at tank car, transport truck, or distributor shall be designed and constructed to heat material without burning, scorching, or overheating and with positive control of the heat. The introduction of steam directly into material will not be permitted.
   3. Distributors: Distributors used to apply asphalt material shall be self-propelled, equipped with pressure type mechanical circulating pumps and valves, a heating system and insulated tank which will provide uniform required temperature throughout entire contents of distributor tank. Distributor shall have capacity of at least 800 gallons. Detachable distributor units separate from the tank will not be allowed.
      a. Distributor shall uniformly apply heated asphalt material to road surface in accurately measured quantities, and maintain specified rate of application during the distribution of the entire tank-load, regardless of change in gradient, super-elevation, direction, or content level in the tank. Calibration runs for verification shall be made at the start of the work.

b. Spray nozzles shall be designed, sized, and arranged to insure uniform distribution of heated asphalt material at the designated rate, in an overlapping fan-shaped spray without surge, streaks, ridges, or bare spots. A strainer shall be provided in the discharge line to prevent nozzles from clogging. The output of each and every nozzle on the bar shall be the same and a test shall be made, in advance of use to determine compliance with this requirement. Different sizes, heights, pressures, and settings of nozzles for different designated areas shall be provided.

c. The distributor shall be equipped with a tachometer, clearly visible to the operator, which accurately shows the speed in feet per minute.

d. Pressure metering distributors shall be furnished with an accurate pressure gage showing the distribution pressure. Volume metering distributors shall be furnished with a pump tachometer or meter showing the volume furnished. The distributor shall include an accurate, mercury-actuated thermometer showing the temperature of the material in the tank and a contents gage showing the number of gallons in the tank at any content level.

e. The distributor shall be equipped with adjustable spray bars arranged so the application width will be available in two foot intervals from four (4) feet to at least 16 feet.

f. The distributor spray bars shall be capable of operating at constant controlled height and shall be of the full circulating type. Each nozzle of the distributor bar shall be equipped with a cutoff valve which immediately stops the flow without dripping. Compliance with these requirements must be proven before the distributor can be used.

3.2 SURFACE PREPARATION

A. The Contractor shall adjust the gate valve boxes and manholes to the top of surfacing and grout water tight prior to placing the surfacing. This work will be absorbed into the project bid items.

B. The surface shall be thoroughly swept with a rotary power broom and cleaned of all foreign material. Adjacent appurtenances shall be protected from the splatter of asphalt. Surfaces to receive a prime coat shall be satisfactorily compacted and cured and if necessary, lightly sprinkled with water.

3.3 APPLICATION OF ASPHALT

A. During application, the temperature of the asphalt shall be maintained within the temperature range specified. Asphalt shall be applied by pressure distributor in a uniform and continuous manner.

B. Unauthorized increases in rate of application will not be eligible for payment.

C. The angle of the spray nozzles and the height of the spray bars shall be set to obtain uniform distribution. The distributor shall travel at the established speed when the

spray bar is opened. Areas inaccessible to the distributor shall be covered by hand-spray methods. When the distributor is not in operation, it shall be parked off the roadbed or drip pans shall be placed under the spray bar.

D. Tack application ahead of mat lay down shall be limited by job conditions and be subject to approval. Tack application ahead of mat lay down shall not exceed the amount estimated for one (1) day's operation.

E. Tacked areas which become unsatisfactory as a result of traffic, weather, or other conditions shall be retacked. Required re-tacking which is not the fault of the Contractor, will be paid for at the contract unit price for tack asphalt.

3.4 APPLICATION OF SAND

A. Blotting of prime coats shall be accomplished by broom sweeping or by spreading sand on the primed surface by with a mechanical spreader. Hand spreading will be permitted on odd shaped or inaccessible areas. Sanding or blotting will not be permitted until the prime has set for at least 24 hours.

3.5 TRAFFIC CONTROL

A. Contractor shall provide flaggers, signs, and barriers to warn, direct, and prevent traffic from traveling on freshly applied asphalt until it has penetrated, and does not track or pickup on the tires of vehicles.

END OF SECTION

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES

1. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.
2. The work performed under this section shall consist of constructing a pavement composed of asphaltic concrete as specified, constructed on a prepared subgrade or base course in accordance with these Specifications, and in reasonably close conformity with the lines, grades, thickness, and cross-sections shown on the plans or Contract Documents as well as cold milling of existing asphalt pavement.
3. Hot-mix asphalt patching.
4. Hot-mix asphalt paving
5. Hot-mix asphalt overlay
6. Asphalt curbs
7. Asphalt traffic-calming devices.
8. Asphalt surface treatments

B. RELATED REQUIREMENTS

1. Section 31 23 13 - Subgrade Preparation
2. Section 32 11 23 - Aggregate Base Course
3. Section 32 12 13 - Preparatory Coats
4. Section 32 12 36 - Seal Coats
5. Section 32 17 23 - Pavement Markings
6. Section 32 16 13 - Curb and Gutter
7. The following sections of the “GREENBOOK” Standard Specifications for Public Works Construction, 2018 Edition, written and promulgated by Public Works Standards, Inc. and published by BNI Building News, 990 Park Center Drive, Vista, CA 92081 shall be included in this specification as if fully written:
   a. Section 200 - Rock Materials
   b. Section 203 - Bituminous Materials
   c. Section 302 - Roadway Surfacing
   d. Section 404 - Cold Milling
   e. Section 405 - Micro-Milling

1.2 SUBMITTALS

A. Design Mix: Before any asphaltic concrete paving is constructed, submit actual design mix to Engineer/Architect for review and/or approval. Design mix submittal shall follow the format as indicated in the Asphalt Institute Manual MS-2, Marshall Stability Method; and shall include the type/name of the mix, gradation analysis, Marshall Stability (lbs.), flow, effective asphalt content (percent), and direct references to the applicable "GREENBOOK" specifications sections for each material. Mix designs submitted containing recycled materials must be current (within one year) and be approved by the City of Duarte.

B. Material Certificates: Submit materials certificate to on-site independent testing laboratory. Certificate shall be signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include technical data and tested physical and performance properties.
   2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
   3. Job-Mix Designs: For each job mix proposed for the Work.

B. Sustainable Design Submittals:
   1. To be submitted to Engineer for review and approval.

C. Hot-Mix Asphalt Designs:
   1. Certification, by authorities having jurisdiction, of approval of each hot-mix asphalt design proposed for the Work.
   2. For each hot-mix asphalt design proposed for the Work.

D. Samples for Verification: For the following product, in manufacturer's standard sizes unless otherwise indicated:
   1. Paving Geotextile: 12 by 12 inches minimum.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data for manufacturer and testing agency.

B. Material Certificates: For each paving material. Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials as applicable.

C. Material Test Reports: For each paving material, by a qualified testing agency.

D. Field quality-control reports.

E. Material Certificates:
   1. Aggregates.
   2. Asphalt binder.
   3. Asphalt cement.
   4. Cutback prime coat.
   5. Emulsified asphalt prime coat.
   6. Tack coat.
   7. Fog seal.
   8. Undersealing asphalt.

F. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt material if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
   1. Prime Coat: Minimum surface temperature of 60 deg F.
   2. Tack Coat: Minimum surface temperature of 60 deg F.
   3. Slurry Coat: Comply with weather limitations in ASTM D3910.
   4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
   5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

1.6 JOB CONDITIONS

A. Weather Limitations
   1. Apply prime and tack coats when ambient temperature is above 40 degrees F, and when temperature has been above 35 degrees F for 12 hours immediately prior to application. Do not apply when base material is wet or contains excess moisture.
   2. Construct asphaltic concrete paving when atmospheric temperature is above 40 degrees

B. Hot-Mix Asphalt Designs:

1. Certification, by authorities having jurisdiction, of approval of each hot-mix asphalt design proposed for the Work.
2. For each hot-mix asphalt design proposed for the Work.

C. Samples for Verification: For the following product, in manufacturer's standard sizes unless otherwise indicated:
1. Paving Geotextile: 12 by 12 inches minimum.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction.

B. Testing Agency Qualifications: Qualified in accordance with ASTM D3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of authorities having jurisdiction for asphalt paving work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide asphalt-aggregate mixture as recommended by local or state paving authorities to suit project conditions. Use locally available materials and gradations which meet “GREENBOOK” specifications and exhibit satisfactory record of performance on previous installations.

B. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with AASHTO M-17/ASTM D242, if recommended by applicable “GREENBOOK” standards.

C. Asphalt Cement: Comply with AASHTO M-226/ASTM D3381; AC-20, AR-80, viscosity grade.

D. Tack Coat: Emulsified Asphalt; AASHTO M-140/ASTM D997 or M208/ASTM D2397, SS-1h, CSS-1, or CSS-1h, diluted with one part water to one part emulsified asphalt.

E. Asphalt-Aggregate Mixture: Unless otherwise noted on the drawings, the design mix shall have a minimum stability based on a 50- blow Marshall complying with ASTM D1559 of 1000 lbs., with flow between 8 and 16. The design mix shall be within sieve analysis and bitumen ranges below:

Sieve Analysis of Mix

Square Sieve	Total Percent Passing
¾	100%
½	90 – 100%
3/8	65 – 90%
#8	40 – 50%
#50	12 – 27%
#200	0 – 10%

Percent bitumen by weight of total mix 5.0 – 8.5

Density percent of calculated voidless mixture of material. 94 – 97 %

F. Once design mix has been accepted by Engineer / Architect, the following sieve analysis tolerances are allowable during construction, beyond which design mix must be resubmitted for acceptance.

Square Sieve	Total Percent Passing
½	7%
3/8	5%
#8	4%
#50	4%
#200	2%

Allowable variance of percent bitumen by weight of total mix = .4.

2.2 EQUIPMENT

A. Maintain equipment in satisfactory operating condition and correct breakdowns in a manner that will not delay or be detrimental to progress of paving operations.

2.3 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D1073 sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D242, rock or slag dust, hydraulic cement, or other inert material.

2.4 ASPHALT MATERIALS

A. Asphalt Binder: ASTM D6373 binder designation PG 64-22.

B. Asphalt Cement: ASTM D3381 for viscosity-graded material, ASTM D946 for penetration-graded material.

C. Cutback Prime Coat: ASTM D2027, medium-curing cutback asphalt, MC-70.

D. Emulsified Asphalt Prime Coat: ASTM D977 emulsified asphalt, or ASTM D2397 emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

E. Tack Coat: ASTM D977 emulsified asphalt, or ASTM D2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

F. Fog Seal: ASTM D977 emulsified asphalt, or ASTM D2397 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

G. Water: Potable.

H. Undersealing Asphalt: ASTM D3141; pumping consistency.

2.5 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires or asphalt shingles from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

C. Sand: ASTM D1073, Grade No. 2 or No. 3.

D. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

E. Joint Sealant: ASTM D6690, Type I, Type II or III, Type IV, hot-applied, single-component, polymer-modified bituminous sealant.

2.6 MIXES

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Asphalt Mix Design Methods"; and complying with the following requirements:
   1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
   2. Base Course: <Insert mix designation>.
   3. Surface Course: <Insert mix designation>.

B. Emulsified-Asphalt Slurry: ASTM D3910, [Type 1] [Type 2] [Type 3].

C. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
   1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
   2. Base Course and Surface Course: AR-2000 or AR-4000.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

C. Proof-roll prepared base material surface to check for unstable areas. The paving work shall begin only after the unsuitable areas have been corrected and are ready to receive paving. Compaction testing for the base material shall be completed prior to the placement of the paving

D. Verify paving base course elevation.

3.2 PREPARATION

A. Remove loose material, dirt, and debris from compacted base material surface immediately before applying prime coat.

B. Do not begin paving work until deficient base material areas have been corrected and area ready to receive paving

C. Do not construct paving on a wet or frozen base.

D. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.

E. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction]. Limit vehicle speed to 3 mph.
   2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
   3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

3.3 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd.
   1. Allow tack coat to cure undisturbed before applying hot mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

D. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.4 REPAIRS

A. Leveling course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
   1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
   1. Clean cracks and joints in existing hot-mix asphalt pavement.
   2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch (6 mm) wide.
      a. Fill flush with surface of existing pavement and remove excess.
   3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch (6 mm) wide.
      a. Fill flush with surface of existing pavement and remove excess.

3.5 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving. Compact top 12” to minimum 90% relative compaction

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
   2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
   3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Herbicide Treatment: Apply herbicide in accordance with manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

3.6 BITUMINOUS MATERIAL APPLICATIONS

A. Prime Coat
   1. Apply bituminous prime coat to all base material surfaces where asphaltic concrete paving will be constructed.
   2. Apply bituminous prime coat in accordance with applicable “GREENBOOK” specifications
   3. Apply at a minimum rate of 0.375 gallon per square yard over compacted base material. Apply to penetrate seal, but not flood surface.
   4. Make necessary precautions to protect adjacent areas from overspray.
   5. Cure and dry as long as necessary to attain penetration and evaporation of volatile.

B. Tack Coat
   1. Apply to contact surfaces of previously constructed asphaltic concrete base courses or Portland cement concrete and surfaces abutting or projecting into asphaltic concrete and pavement.
   2. Apply tack coat to asphaltic concrete base course or sand asphalt base course. Apply emulsified asphalt tack coat between each lift or layer of fill depth asphaltic concrete and sand asphalt bases and on surface of all such bases where asphaltic concrete paving will be constructed.
   3. Apply emulsified asphalt tack coat in accordance with applicable “GREENBOOK” specifications.
   4. Apply at minimum rate of 0.075 gallon per square yard of surface.
   5. Allow to dry to proper condition to receive paving.

3.7 HOT-MIX ASPHALT PLACEMENT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
   1. Place hot-mix asphalt base course and binder course in number of lifts and thicknesses indicated.
   2. Place hot-mix asphalt surface course in single lift.
   3. Spread mix at a minimum temperature of 250 deg F.
   4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.

5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
   1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
   2. Complete a section of asphalt base course and binder course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.8 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
   1. Clean contact surfaces and apply tack coat to joints.
   2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
   3. Offset transverse joints, in successive courses, a minimum of 24 inches.
   4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method in accordance with AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
   5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
   6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.9 ROLLING AND COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
   1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for

indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
   1. Average Density, Marshall Test Method: 96 percent of reference laboratory density in accordance with ASTM D6927, but not less than 94 percent or greater than 100 percent.
   2. Average Density, Rice Test Method: 92 percent of reference maximum theoretical density in accordance with ASTM D2041, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 QUALITY ASSURANCE

A. Independent testing laboratory, selected and paid by Owner, shall be retained to perform construction testing of in-place asphaltic concrete courses for compliance with requirements for thickness and surface smoothness. Asphaltic surface and base courses shall be randomly cored at a minimum rate of one core for every 20,000 square feet of paving. However, no less than three cores in light duty areas and three cores in heavy duty areas shall be obtained. Coring holes shall be immediately filled with full-depth asphalt or with concrete. Asphaltic concrete pavement samples shall be tested for conformance with the mix design.

3.11 QUALITY CONTROL

A. Grade Control: Establish and maintain required lines and elevations.

B. Thickness: In-place compacted thickness shall not be less than thickness specified on drawings.

C. Surface Smoothness: Testing shall be performed on the finished surface of each asphalt concrete course for smoothness, using 10'- 0" straightedge applied parallel with, at right angles to, and centerline of paved area. The results of these tests shall be documented and made available to the Architect and Owner. Surfaces will not be acceptable if exceeding the following tolerances for smoothness:

Base Course Surface		¼”
Wearing Course Surface		3/16”

D. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable paving as directed by Engineer.

Areas of deficient paving thickness shall receive a tack coat and a minimum 1” overlay until specified thickness of the course is met or exceeded at no additional expense to Owner.

3.12 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce thickness indicated within the following tolerances:

1. Base Course and Binder Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course and Binder Course: 1/2 inch
2. Surface Course: 1/4 inch no minus
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

C. Asphalt Traffic-Calming Devices: Compact and form asphalt to the shapes indicated and within a tolerance of plus or minus 1/8 inch of height indicated above pavement surface.

3.13 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.

B. Slurry Seals: Apply slurry coat in a uniform thickness in accordance with ASTM D3910 and allow to cure.
   1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined in accordance with ASTM D3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement in accordance with ASTM D979.
   1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared in accordance with ASTM D2041, and compacted in accordance with job-mix specifications.
   2. In-place density of compacted pavement will be determined by testing core samples in accordance with ASTM D1188 or ASTM D2726.
      a. One core sample will be taken for every 1,000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
      b. Field density of in-place compacted pavement may also be determined by nuclear method in accordance with ASTM D2950 and coordinated with ASTM D1188 or ASTM D2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.15 CLEANUP / WASTE HANDLING

A. General: Handle asphalt-paving waste according to approved waste management plan.

B. Upon completion of asphalt paving and surfacing operations, the entire work site shall be cleaned of all containers, surplus material, equipment, waste, rubbish, and construction debris of any nature, and leave the site in a clean and orderly condition acceptable to the Owner's Representative.

END OF SECTION

SECTION 32 12 36 - SEAL COATS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section includes all work related to furnishing all materials and the application of a bituminous seal coat.

1.2 ADDITIONAL REQUIREMENTS

1.3 REFERENCES

A. The following Sections of the "GreenBook" Standard Specifications for Public Works Construction, 2018 Edition, written and promulgated by Public Works Standards, Inc. and published by BNi Building News, 990 Park Center Drive, Suite E, Vista, CA 92081 shall be included in this specification as if fully written:
   1. Section 302-4 - Slurry Seal Surfacing
   2. Section 320-8 - Seal Coat for Miscellaneous Areas

1.4 QUALITY ASSURANCE

A. Source Quality Control:
   1. SS-1h Flush Seal: AASHTO M140.
   2. Slurry Seal: ASTM D6307

1.5 FIELD CONDITIONS

A. Weather and Seasonal Requirements:
   1. Application shall be made only during daylight hours, when the wind does not adversely affect the spraying operation and when the following conditions are met:
   2. The application of a seal coat will be permitted only:
      a. Between May 1 and November 1, inclusive.
      b. When air and surface temperatures on the project are both at least 50° F in the shade.
      c. When weather is not foggy or rainy.
      d. When the surface is dry or slightly damp.

PART 2 - PRODUCTS

2.1 SAND FOR FLUSH SEAL

A. Flush Seal: GSB-78
   1. SS-1h: AASHTO M140

B. Sand for flush seal shall meet the following requirements:

Percent passing 3/8" sieve:	100%
Percent passing No. 10 sieve:	0 - 95%
Percent passing No. 40 sieve:	0 - 70%
Percent passing No. 200 sieve:	0 - 12%

C. A tolerance of three percent (3%) in the amount passing the maximum size screen will be permitted providing all material passes a screen having 1/4 inch larger opening.

D. The sand shall be free from dirt and vegetable matter and shall have a plasticity index not to exceed six (6). Crushing is not required. Blow sand is not considered satisfactory material.

2.2 BITUMINOUS MATERIAL

A. Bituminous material used for seal coating shall conform to the specifications and requirements for ASTM D2027, HFMS-2P Asphalt Material.

2.3 MINERAL AGGREGATE

A. Mineral aggregate used for seal coat operations shall shall be 3/8" crushed granite conform and to the gradation and quality requirements as follows:

Percent Passing 3/8" Sieve:	100%
Percent Passing No. 4 Sieve:	0 - 70%
Percent Passing No. 10 Sieve:	0 - 28%
Percent Passing No. 40 Sieve:	0 - 4
Processing Required:	Crushed
Plasticity Index (Maximum):	3
Los Angeles Abrasion Loss Maximum:	40%

Soundness Loss Maximum:	15%

At least fifty percent of the material by weight retained on the No. 4 sieve shall have two or more fractured faces produced by crushing.

PART 3 - EXECUTION

3.1 EQUIPMENT

A. The following minimum equipment shall be furnished by the Contractor.
   1. General Requirements: Equipment, plant, and tools used in the Work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the results specified.
   2. Heating Equipment: Equipment for heating asphalt material in or at tank car, transport truck, or distributor shall be designed and constructed to heat material without burning, scorching, or overheating and with positive control of the heat. The introduction of steam directly into material will not be permitted.
   3. Distributors: Distributors used to apply asphalt material shall be self-propelled, equipped with pressure type mechanical circulating pumps and valves, a heating system and insulated tank which will provide uniform required temperature throughout entire contents of distributor tank. Distributor shall have capacity of at least 800 gallons. Detachable distributor units separate from the tank will not be allowed.
      a. Distributor shall uniformly apply heated asphalt material to road surface in accurately measured quantities, and maintain specified rate of application during the distribution of the entire tank-load, regardless of change in gradient, super-elevation, direction, or content level in the tank. Calibration runs for verification shall be made at the start of the work.
      b. Spray nozzles shall be designed, sized, and arranged to insure uniform distribution of heated asphalt material at the designated rate, in an overlapping fan-shaped spray without surge, streaks, ridges, or bare spots. A strainer shall be provided in the discharge line to prevent nozzles from clogging. The output of each and every nozzle on the bar shall be the same and a test shall be made, in advance of use to determine compliance with this requirement. Different sizes, heights, pressures, and settings of nozzles for different designated areas shall be provided.
      c. The distributor shall be equipped with a tachometer, clearly visible to the operator, which accurately shows the speed in feet per minute.
      d. Pressure metering distributors shall be furnished with an accurate pressure gage showing the distribution pressure. Volume metering distributors shall be furnished with a pump tachometer or meter showing the volume furnished. The distributor shall include an accurate, mercury-actuated thermometer showing the temperature of the material in the tank and a contents gage showing the number of gallons in the tank at any content level.

e. The distributor shall be equipped with adjustable spray bars arranged so the application width will be available in two foot intervals from four (4) feet to at least 16 feet.

f. The distributor spray bars shall be capable of operating at constant controlled height and shall be of the full circulating type. Each nozzle of the distributor bar shall be equipped with a cutoff valve which immediately stops the flow without dripping. Compliance with these requirements must be proven before the distributor can be used.

4. Aggregate Spreader: The aggregate spreading equipment shall be adjustable and capable of uniformly spreading aggregate at the specified rate in a single-pass operation over the surface to be sealed.

5. Pneumatic-Tired Roller: The pneumatic-tired roller shall be of sufficient size to seat the cover aggregate into the bituminous material without fracturing the aggregate particles.

6. Power Brooms and Power Blowers: Power brooms and power blowers shall be suitable for cleaning surfaces to which the seal coat is to be applied.

7. Storage Tanks: Tanks shall be capable of heating the bituminous material, under effective and positive control at all times, to the required temperature. Heating shall be accomplished by steam coils, hot oil, or electricity. An armored thermometer shall be affixed to the tank so that the temperature of the bituminous material may be read at all times.

3.2 SURFACE PREPARATION

A. The Contractor shall adjust the gate valve boxes and manholes to the top of surfacing and grout water tight prior to placing the surfacing. This work will be absorbed into the project bid items.

B. The surface shall be thoroughly swept with a rotary power broom and cleaned of all foreign material. Adjacent appurtenances shall be protected from the splatter of asphalt. Surfaces to receive a prime coat shall be satisfactorily compacted and cured and if necessary, lightly sprinkled with water.

3.3 APPLICATION OF BITUMINOUS MATERIAL

A. During application, the temperature of the asphalt shall be maintained within the temperature range specified. Asphalt shall be applied by pressure distributor in a uniform and continuous manner.

B. Unauthorized increases in rate of application will not be eligible for payment.

C. The angle of the spray nozzles and the height of the spray bars shall be set to obtain uniform distribution. The distributor shall travel at the established speed when the spray bar is opened. Areas inaccessible to the distributor shall be covered by hand-spray methods. When the distributor is not in operation, it shall be parked off the roadbed or drip pans shall be placed under the spray bar.

D. Application Rate:
   1. Bituminous material for seal coating HFMS-2P or AE-150 shall be applied at a rate of 0.30 Gal./SY. If necessary to adjust the application rate to suit field conditions, adjustments will be approved by the Engineer before commencing with work at a rate other than specified.
   2. Flush Seal shall be applied at a rate of 0.05 GAL./SY.

E. Following the preparation and inspection of the pavement surface, the seal coat material shall be applied at the specified rates. The bituminous material shall be uniformly applied in a single pass of the distributor and with either a double or triple lap spray over the surface to be sealed. Building paper shall be spread on the surface for a sufficient distance back from the ends of each application so that flow through the spray bar may be started and stopped on the paper and so that all sprays will be operating at the proper pressure on the surface to be sealed. Immediately after the application, the building paper shall be removed. Spots missed by the distributor shall be properly treated with bituminous material.

3.4 APPLICATION OF SAND

A. For Seal Coats: The specified quantity of cover aggregate shall be spread uniformly over the bituminous material at a rate of 30lbs/SY. Before the bituminous material is applied, sufficient aggregate to cover the distributor load of bituminous material shall be on trucks at the site of the work. No bituminous material shall be down more than 3 minutes before it is covered with aggregate. Spreading shall be done uniformly with aggregate-spreading equipment. Trucks spreading aggregate shall be operated backwards, covering the bituminous material ahead of the truck wheels. Areas having insufficient cover shall be lightly recovered with additional aggregate by hand during the operations whenever necessary. Immediately following the application of cover aggregate, rolling operations shall begin. Rolling shall be accomplished with pneumatic-tired rollers. The rollers shall be operated at a speed that will not displace the aggregate. Rolling shall continue until the aggregate is uniformly distributed and keyed into the bituminous material. All surplus aggregate shall be swept off the surface and removed not less than 24 hours nor more than 7 days after rolling is completed.

B. For Flush Seal: May be covered with a spread of sand to blot the material. Sand shall be placed by a self-powered aggregate spreader with positive controls or other equipment acceptable to the Engineer. The sand shall be placed uniformly on the asphalt application at a rate of 15lbs/SY. Rolling will not be required. The finished surface shall be smooth riding without transverse or longitudinal ridges and shall present a uniform satisfactory appearance. Bleeding areas shall be re-sanded. Rough and non-uniform areas shall be corrected.

3.5 SAMPLING AND TESTING

A. Bituminous Materials: One sample of the bituminous material used for seal coat will be required. The sample will be taken by the Contractor from the transport delivery