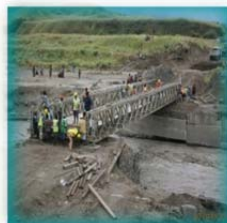




Department of Works

Highway Maintenance Specifications

Revised and Re-issued October 2017





Foreword

Department of Works (DoW) is the main technical arm of the Government, responsible for management and development of Papuan New Guinea's National Road Network (NRN) which provides the enabling environment to foster economic and social development. The Department is also responsible for developing and maintaining highway engineering and building standards as well as specifications for road and bridge construction works.

Since the development of the Road and Bridge Works Specification in 1978, supplementary specifications were continuously added where appropriate, to address the maintenance works in DoW's maintenance works contracts. Delivering high quality road works is paramount to DoW, as it continuously seeks to improve value for money in road maintenance activities. DoW has recently developed the Highway Maintenance Specification (HMS), focused specifically on setting and enforcing appropriate standards for road maintenance works throughout the country. The Highway Maintenance Specification is a stand-alone document that will complement the Road and Bridge Works Construction Specifications. In that context, the clause numbering in Road and Bridge Works Construction Specification ends at Clause 21 and the Highway Maintenance Specification commences from Clause 51. The gap in the clause numbering allows for additional clauses to be added later where appropriate in the Construction Specification.

This Highway Maintenance Specification is an important part of Department's continuous development drive, to achieve its long-term object of a sustainable national road network as captured in the National Road Network Strategy.

Proposed amendments for consideration on this Highway Maintenance Specification should be sent to First Assistant Secretary (Design Services), Department of Works, P O Box 1108, Boroko, National Capital District.

David Wereh

Secretary -Department of Works PNG



TABLE OF CONTENTS

51.0	GENERAL SPECIFICATIONS
51.1	DEFINITIONS AND INTERPRETATION
51.2	GENERAL SPECIFICATIONS
52.0	SAFETY QUALITY AND ENVIRONMENTAL SPECIFICATIONS
52.1	TRAFFIC CONTROL
52.2	WORK SAFETY
52.3	ENVIRONMENT PROTECTION
52.4	QUALITY CONTROL
53.0	PAVEMENT MAINTENANCE SPECIFICATIONS
53.1	EARTHWORKS
53.2	PIT-RUN GRAVEL
53.3	GRANULAR BASE COURSE
53.4	FORMATION CLEARING GRUBBING AND STRIPPING
53.21	SEALED PAVEMENT CRACK SEALING
53.22	SEALED PAVEMENT POTHOLE PATCHING
53.23	SEALED PAVEMENT SLURRY SURFACING
53.24	SEALED PAVEMENT RECONSTRUCTION PATCHING
53.25	SEALED PAVEMENT REGULATION PATCHING
53.26	ASPHALT PAVEMENT SURFACE MAINTENANCE
53.27	SEALED PAVEMENT SPRAY SEALING FOR MAINTENANCE
53.28	SEALED PAVEMENT REPAIR OF EDGE BREAK
53.29	MAINTENANCE OF UNSEALED SHOULDERS
53.41	MAINTENANCE AND PREPARATION OF GRAVEL SURFACED ROADS
53.42	SPOT GRAVELLING
53.43	GRAVEL SURFACING (SHEETING)
53.44	GRAVEL PAVEMENT POTHOLE PATCHING
53.61	ROADWAY AND RAISED MEDIAN CLEANING
53.62	SAW CUTTING OF ASPHALT CONCRETE PAVEMENT
53.63	PAINTED ROADWAY LINES
53.64	RAISED PAVEMENT MARKERS



54.0	ROADSIDE MAINTENANCE SPECIFICATIONS
54.1	ROADSIDE VEGETATION CONTROL
54.2	CHEMICAL VEGETATION CONTROL
54.3	MAINTENANCE OF HIGHWAY SIGNS
54.4	PAINTING STEEL POSTS AND FRAMES AND SIGN STRUCTURES
54.5	GUIDE POSTS
54.6	REMOVE AND DISPOSE OF GUARDRAILS, CABLE BARRIERS AND POSTS
54.7	W-BEAM GUARDRAILS AND POSTS
54.8	CLEANING DRAINS
54.9	MAINTAINING DRAINS
55.0	CROSS-DRAINAGE STRUCTURES MAINTENANCE SPECIFICATIONS
55.1	BRIDGE MAINTENANCE
55.2	BRIDGE STRUCTURE CLEANING
55.6	CLEANING CULVERTS
55.8	REMOVAL OF CULVERTS
55.9	SUPPLY AND INSTALLATION OF CULVERTS
55.10	REPAIR OF CULVERTS
56.0	MISCELLANEOUS SPECIFICATIONS
56.2	HAULING
56.31	SUPPLY OF ARROWBOARDS FOR TRAFFIC CONTROL
56.32	SUPPLY OF FLAGPERSONS FOR EMERGENCY TRAFFIC CONTROL



51.0 GENERAL SPECIFICATIONS

- 51.1 DEFINITIONS AND INTERPRETATION
- 51.2 GENERAL SPECIFICATIONS



51.1 DEFINITIONS & INTERPRETATIONS

51.1.1 GENERAL

All definitions, employee titles and Department descriptions are subject to change based on prescribed operational parameters.

51.1.2 DEFINITIONS & INTERPRETATIONS

51.1.2.1 ACTIVITY

"Activity" shall mean the amount of related Work that applies to a specific roadway maintenance operation and may involve one or more bid items.

51.1.2.2 ADHESION AGENT

A substance used for the purpose of promoting the adhesion between binder and aggregate.

51.1.2.3 BASE

That layer of pavement immediately above the subgrade or sub-base and/or below the bituminous surfacing extending for the full width of the traffic lanes.

51.1.2.4 BID ITEM

"Bid Item" shall mean the quantity of Work for which a single unit price is paid.

51.1.2.5 BORROW PIT

An excavation outside the formation limits for obtaining fill, gravel, rock and rubble.

51.1.2.6 CARRAIGEWAY

That portion of a road for the use of vehicles, that is between kerbs or barriers where these are provided, including shoulders and auxiliary lanes.

51.1.2.7 CATCH DRAIN

A surface channel constructed along the high side of a road or embankment, outside the batter, to intercept the water.

51.1.2.8 COLD MIX ASPHALT

A premix, blended from bitumen, aggregate, sand, and mineral filler, and having a flux oil in the binder. It is workable at ambient temperatures.

51.1.2.9 CONTENT

Dry mass of the material, at which maximum modified dry density is obtained with the stabiliser added.

51.1.2.10 CONTRACT

"Contract" shall mean the written agreement covering the performance of the Work and the supplying of labour, equipment and material required to complete the Work, and shall include, without limiting the generality of the foregoing, the Contractor's Proposal, Security, Plans, Specifications, Special Provisions, notices, supplemental specifications, specification amendments and all supplemental agreements required to complete the Work.

51.1.2.11 CONTRACTOR

"Contractor" shall mean the person agreeing to perform the Work set out in the Contract.



51.1.2.12 CONTRACTOR'S BID

"Contractor's Bid" or "Bid" shall mean the document submitted by the Contractor in response to the Employer's Invitation for Bids.

51.1.2.13 COARSE GRAINED AGGREGATE

Where the average grain size of the constituent minerals is $> 1\text{mm}$. The average grain size is determined optically under a petrographic microscope.

51.1.2.14 CUTTER

A light petroleum distillate (kerosene) added to bitumen to temporarily reduce its viscosity.

51.1.2.15 DEPARTMENT

"Department" shall mean the Department of Works, which is a Department of the Government of Papua New Guinea.

51.1.2.16 DRY DENSITY RATIO

The percentage ratio of the field dry density of a material to the modified maximum dry density of that material. This property is also termed Relative Compaction.

51.1.2.17 EMPLOYER

"Employer", for the purpose of these Specifications, shall mean the Independent State of Papua New Guinea

51.1.2.18 EMPLOYER'S REPRESENTATIVE

"Employer's Representative", shall mean the person named in the Contract as representing the Employer, for the purpose of administering the Contract.

51.1.2.19 ENGINEER

The "Engineer" shall mean the person designated by the Employer's Representative to administer the Contract, and shall include a person authorized by the Engineer to perform, on his behalf, any of his functions under the Contract.

51.1.2.20 ENGINEER'S REPRESENTATIVE

"Engineer's Representative" shall mean the person, agent or official authorized by the Engineer to perform, on his behalf, any of his functions under the Contract.

51.1.2.21 EXOTIC PLANTS

Any plants not native to Papua New Guinea.

51.1.2.22 FINE GRAINED AGGREGATE

Where the average grain size of the constituent minerals is $< 1\text{mm}$. The average grain size is determined optically under a petrographic microscope.

51.1.2.23 FLUXING

A petroleum distillate (diesel) used to produce a long term reduction in the viscosity of a binder.

51.1.2.24 FLUX OIL

A petroleum distillate (diesel) used to produce a long term reduction in the viscosity of a binder.

51.1.2.25 FORMATION WIDTH

The width of cut or fill, including table drains, out to the points of any batters.



51.1.2.26 HERBICIDE

A chemical formulation for control and eradication of vegetation and weeds.

51.1.2.27 HOT MIX ASPHALT

A hot mixed homogeneous blend of bitumen, aggregates, sand, and mineral fillers produced at an approved asphalt plant. It is delivered, placed and compacted hot.

51.1.2.28 JOB MIX

The mix utilised for asphalt surfacing which is determined from laboratory testing of proposed materials and complies with the specified properties.

51.1.2.29 MATERIAL

"Material" shall mean all or any part of the commodities or other item used or expended in the prosecution of the Work and includes materials furnished by the Contractor or by the Department for use by the Contractor. **51.1.2.30 MULCH**

Stable material spread as a surface treatment to reduce soil erosion, water loss, and weed invasion.

51.1.2.31 NATIVE PLANTS

Plants that are natural to Papua New Guinea.

51.1.2.32 OFFLET DRAIN

A diversion from a table drain to a point where the water will dissipate.

51.1.2.33 OPTIMUM MOISTURE CONTENT

The amount of water by mass, expressed as a percentage of the dry mass of the material, at which maximum modified dry density is obtained with the stabiliser added.

51.1.2.34 PAVEMENT

That portion of a carriageway, including the traffic lanes and shoulders, placed above the sub grade for the support of, and to form a running surface for, vehicular traffic.

51.1.2.35 PAVEMENT PROFILING

The use of a pavement profiler to remove worn, oxidised, aged or out of shape pavements, and for correcting poor surface conditions to make the pavement suitable for re-sheeting or resealing.

51.1.2.36 PLANS

"Plans" shall include all drawings or reproductions of drawings provided by the Department and pertaining to the Work.

51.1.2.37 PRECOATING MATERIAL

A material used for precoating aggregate to promote adhesion of bitumen.

51.1.2.38 RECONSTRUCTION PATCHING

Repairs with profiling, dig-out and/or squaring up, may be confined to the surface course or extend through all courses.

51.1.2.39 REGULATION PATCHING

Surface repairs and shape correction without dig-out and/or squaring up, will usually not be straight sided due to irregularities in the pavement and feathering repair techniques.

51.1.2.40 ROCK

Hard naturally occurring elastic material which is not significantly affected by immersion in water and cannot be dug with construction equipment normally used for the particular operation.



51.1.2.41 ROUGHNESS

The roughness of the finished road surface in counts/km as measured by a Roughness Meter.

51.1.2.42 SHOULDER

The portion of the carriageway beyond the traffic lanes and contiguous and flush with the surface of the pavement.

51.1.2.43 SPECIFICATIONS

"Specifications" shall include all specifications and Plans and the directions, schedules, Special Provisions and requirements contained herein, together with all written agreements made or to be made, pertaining to the method and manner of performing the Work, or to the quantities or quality of Material to be furnished under the Contract.

51.1.2.44 STOP BERM

An independent blockage of a table drain or a diversion of flow into a culvert.

51.1.2.45 SUBGRADE

Top 150 mm of material below subgrade surface.

51.1.2.46 SUBGRADE SURFACE

The prepared surface immediately beneath the pavement and shoulder layers.

51.1.2.47 SURFACE FORMATION

The formation of a road from material generally cut from the table drains.

51.1.2.48 TABLE DRAIN

The side drain of a road adjacent to the shoulders, having its invert lower than the pavement base and being part of the formation.

51.1.2.49 TABLE DRAIN BLOCK

A block constructed in a table drain to divert water into an offlet drain.

51.1.2.50 VEGETATION

Refers to any plant growth, grasses, shrubs or trees in the area to be treated.

51.1.2.51 WEARING SURFACE

The section of pavement upon which the traffic travels. This includes the layer(s) of asphalt or spray seal in a flexible pavement above the base.

51.1.2.52 WEEDS

Refers to undesirable vegetation in the area to be treated.

51.1.2.53 WINDROW

A shallow ridge of material formed by the action of a grader, or other blade, during in situ cutting or mixing operations.

51.1.2.54 WORK

"Work" shall mean all or any part of the work to be performed by the Contractor under the Contract, as directed by the Engineer, whether complete or incomplete, and any or all of the equipment, Material and labour supplied by or for the Contractor.



51.2 GENERAL SPECIFICATIONS

51.2.1 SCOPE OF WORK

This Specification sets out the general requirements for the performance of maintenance operations on roadways and bridges under the jurisdiction of the Department of Works. The requirements for maintenance will be identified and scoped by the Department the Work required will usually be defined in the Special Provisions. However, the Contractor shall respond directly to emergency situations relating to the safety of the travelling public.

The limits of the Contract will be specified on a geographical basis, as indicated in the Special Provisions in the Contract documents.

51.2.2 EQUIVALENCY OF STANDARDS AND CODES

Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national or relate to a particular country or region, other authoritative standards that ensure a substantially equal or higher quality than the standards and codes specified shall be accepted subject to the Engineer's prior review and written consent. Differences between the standards specified and the proposed alternative standards shall be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's consent. In the event the Engineer determines that such proposed deviations do not ensure substantially equal or higher quality, the Contractor shall comply with the standards specified in the documents.

51.2.3 SITE MEETINGS

Meetings are to be held at the Site as convened by the Engineer at a minimum interval of once every month. Site Meetings are to be attended by the Contractor or his accredited representative, together with the Engineer or his representative, and may include the Employer's representative(s).

51.2.4 PROTECTION OF PRIVATE PROPERTY

All private property, including gardens, existing fences, trees, structures, etc. not within the Site are to be protected from damage, if necessary by the erection of temporary fences provided at the Contractor's expense. No plants, trees, fences, or other structures are to be removed without the written consent of the Engineer, and if any item not instructed to be removed or altered by the Engineer is damaged, the Contractor shall be responsible for that item's repair, replacement or the cost of compensating the owner of the said property or item.

51.2.5 COMPENSATION NEGOTIATION

Any compensation for the loss of trees, gardens, or any other item required for the Works or clearly required by the Contract or instructed by the Engineer or his accredited representative, shall be negotiated by the Employer. The Contractor shall not enter into such negotiations or make any statement, written or verbal, that may prejudice future negotiations for compensation.

The Contractor is responsible for sourcing and extraction of all materials required for the Works. All negotiations, royalty and compensation for the access to, and acquisition of the said materials, and any related loss or damage to life and or property, shall be the responsibility of the Contractor.



51.2.6 CONTRACTOR'S STAND DOWN TIME

A Provisional Sum has been included in the Bill of Quantities for 'Stand-Down Time'. The Contractor is required to include a daily rate for 'Stand-Down Time' against this Bill of Quantities Item. The daily rate shall represent the cost of 'Stand-Down' to the Contractor, including allowances for loss of profit, which would otherwise be earned but for a delay as defined by this Clause.

Under the provisions of this Clause, the Contractor may submit a claim as stated above for any delays that are agreed "Compensation Events" as defined by GCC Clause 44. Delays due to the reasons mentioned hereunder shall not be deemed as delays that the Contractor shall be entitled to, under the provisions of this Clause:

- (a) Delays caused by or related to normal natural causes such as rain, wind, earthquake, etc;
- (b) Delays due to any instruction by the Engineer to the Contractor, for failing to comply with any of the requirements of the Contract.

Any such delay or claim for such delay shall be registered with the Engineer in writing within 24 hours from the commencement of such delay.

51.2.7 CONTRACTOR'S WARRANTY

During the warranty period, the Contractor shall warrant the Work to be free from any defect or failure and to withstand climatic, maintenance and normal operational conditions. The warranty period for the Work shall be as specified in the Technical Specification applicable to the Work performed. The warranty period shall commence on the date of completion of the Work as determined by the Engineer.

The Contractor shall, at his own expense, repair any such defect or failure which occurs in the Work prior to the expiry of the warranty period. The Engineer and/or the Contractor will identify the warranty items during the warranty period and document the repairs required. The Contractor shall make these repairs promptly and in accordance with the method laid out in the Contract, and shall give the Engineer prompt notice of the repair performed.

The warranty period applies to the original work and once repaired in accordance with the Contract, the warranty period for the repaired work will not extend beyond the original expiry date. The repair of the warranty items will normally take place within the warranty period, the Engineer, however, may approve the repair work taking place outside the warranty period if the Contractor is delayed as a result of circumstance beyond his control.

If the Contractor fails to do the repairs promptly or to the satisfaction of the Engineer, the Engineer may then make other arrangements to have the repairs done, the cost of which shall be a debt due and owing by the Contractor to the Employer, which the Engineer will deduct from monthly progress payments due the Contractor or draw funds from the performance security provided by the Contractor.

51.2.8 MOBILIZATION AND DEMOBILIZATION

Allow in the tender for establishment on site, including, but not necessarily limited to, the following:

51.2.8.1 Mobilisation

Transportation and establishment on site, including all ongoing costs, of all the requirements to complete that stage of the work. Mobilisation will not be paid for work within 20 kilometres of the regional post office.

51.2.8.2 Demobilisation

Removal and transportation from site of all temporary and construction facilities and equipment. Restoration of the site, on Practical Completion of the works, compatible with environs.



51.2.8.3 Camp Site/Compound/Workshop

Obtain written permission from the owner or lessee of the land.

Pay all costs associated with the use of the site(s).

Maintain all facilities in good condition.

Remove all facilities, unless otherwise agreed in writing with owner or lessee of land, and restore the site to a clean and tidy condition upon completion of the works.

Assume all responsibility for any current and consequential damage caused to the site as a result of occupation.

The Contractor shall at his own cost have his manpower and equipment mobilized and ready to commence Work on the date and time specified in the Contract for Time of Commencement or prior to Latest Start Date.

Upon expiration of the Contract, the Contractor shall, at his own expense, demobilize his manpower and equipment within 7 calendar days of the Contract termination date.

51.2.9 UTILITIES, HINDRANCE AND DELAYS

During pre-bid site inspection, the Contractor shall be responsible for identifying instances where Utilities may hinder the Works and make allowance in their bid for relocation of utilities where required.

Where utilities hinder the Works, the Contractor shall advise the Engineer in an acceptable format of the requirement for relocation of utilities. Upon receipt of notification from the Contractor, the Engineer will arrange with the utility owners or operators to adjust their utility installations as necessary, within or adjacent to the Work. The Contractor and the utility owners or operators shall meet in the presence of the Engineer to agree on the scope, the schedule and the cost of the adjustment. All such adjustments will be made by the owners or operators, except as otherwise agreed to by between the Contractor and the utility owners or operators, or as provided for in the Special Provisions, or as specifically noted on the Plans. The utility adjustment will be paid for by the Contractor, except as otherwise agreed to between the Contractor and the utility owners or operators.

No additional compensation will be paid by the Department for any delay, inconvenience or damage sustained by the Contractor which is caused by the existence of or adjustment to the utilities. However, if the Work cannot be done in the ordered completion time, an extension will be granted.

The Contractor shall consider in his scheduling those items of the Work essential to the adjustment of the utilities, and the Work shall be scheduled and performed at the time required to accommodate these adjustments. No additional compensation beyond that specified on the Contract will be made by the Engineer.

51.2.10 SAFEGUARDING UTILITY INSTALLATIONS

51.2.10.1 Contractor's Responsibility

The Contractor is responsible for safeguarding all existing and relocated utility installations during the progress of the Work and is liable for any damage to the utility resulting from performance of the Work.

51.2.10.2 Liaison and Location

The Contractor shall ensure that all utility installations are located and clearly marked on the ground before commencing operations. The Contractor is responsible for contacting all affected utility owners or operators to determine the existence and location of all utility installations, maintaining liaison with the utility owners or operators concerning the adjustment of all utilities and coordinating his operations in compliance with Section 51.2.9, Utilities, Hindrances and Delays.



51.2.10.3 Precautionary Measures

The Contractor shall take all precautionary measures as may be necessary when working over, under, or adjacent to utility installations, whether above or below ground, and shall control his equipment and method of operation to prevent damage to any utility and its appurtenances.

Under no circumstances shall the Contractor carry out any operations over or adjacent to any utility until the required adjustments and protection as required for the proposed Work have been completed. Additionally, the Contractor shall provide at least 48 hours notice to the utility owner or operator in advance of commencing operations in that area. After completion of the utility Work by the utility owner or operator, the Contractor shall continue to work in close liaison with the utility owner or operator and, if the utility owner or operator so requires, ensure that a representative of the affected utility owner or operator is present at all times during active equipment operations at that location. The Contractor shall ensure that no equipment crosses or operates over or under any utility installation at locations other than where required protection has specifically been provided, and shall work in close cooperation with the utility owner or operator in the execution of the Work. When the Work is in the vicinity of any unprotected utility installation, the Contractor shall exercise extreme caution to ensure that the utility installation is not damaged by the equipment or applied loads. When haul roads or equipment crossings are required, it shall be the Contractor's responsibility to determine, provide and install any protective works necessary and to observe any other necessary precautions.

51.2.11 STAKES, MARKS AND ENGINEERING TESTS

Stakes or marks may be set by the Engineer to define the location, alignment, elevation, and grade required for the Work. The Contractor shall give the Engineer ample notice of the time and place where the stakes or marks will be needed. The Contractor shall protect, and shall not remove or destroy or permit to be removed or destroyed, the stakes or marks placed on or about the Work by the Engineer.

The Contractor shall satisfy himself before commencing the Work as to the correctness and meaning of all stakes and marks.

When the Engineer provides to the Contractor summaries of engineering test results taken on or about the Work by the Engineer, the Contractor shall satisfy himself as to the meaning and correctness of the engineering test results.

The Contractor shall not take advantage of any apparent error or omission in the Plans, Specifications, stakes, marks, engineering tests, or other measurements done or provided by the Engineer, but shall immediately bring such apparent error or omission to the attention of the Engineer. The Engineer will make corrections and interpretations as may be necessary for the fulfilment of the Plans and Specifications.

The Engineer will consider claims for payment of the Contractor's documented extra costs which have resulted from incorrect stakes, marks or engineering tests that neither the Contractor nor the Engineer has recognized in time to prevent the occurrence of such extra costs or that have been drawn to the attention of the Engineer by the Contractor but have not been corrected in a reasonable period of time.

51.2.12 VOLUNTARY "PARTNERING"

It is the Department's intention to encourage the foundation of a cohesive relationship between the Contractor and its principal subcontractors and suppliers. The working relationship will be structured to draw on the strengths of each organization to identify and achieve common goals. The objectives are effective and efficient Contract performance and completion of the Work within budget, within the specified time, and in accordance with the Plans and Specifications.

The working relationship, to be called "Partnering", will be bilateral in make-up, and participation will be totally voluntary. The Department considers Partnering a critical and key process to the success of the maintenance outsourcing initiative. Any cost associated with implementing this process will be agreed to by both parties and will be shared equally. Each party will be responsible for its own staff's wages during partnering workshop sessions.



The Contractor shall provide notice to the Engineer within 7 days of receipt of the Contract, signed by the Engineer, as to his intentions regarding Partnering.

The establishment of a Partnering agreement for the Contract will not change the legal relationship of the parties to the Contract nor relieve either party from any of the terms of the Contract.

51.2.13 COMMUNICATIONS SYSTEM

The Contractor will be responsible for providing, at his cost, mobile radio units, mobile or fixed telephones and other required hardware, so that communication access is available to the site and each of the Contractor's key personnel.

The cost of all telephone access charges, as well as the cost of installation, removal and maintenance of the radios and or telephones from the site and equipment is the responsibility of the Contractor.

51.2.14 Communication with Outside Agencies and the Public

51.2.14.1 General

The Contractor, upon receipt of an enquiry related to the Works from other parties, shall note the name, address and telephone number of any such party. The Contractor shall, upon request provide such party with the Engineer's address and telephone number. Copies of this information will be provided to the Engineer upon request.

51.2.14.2 Emergency Communications

Prior to starting Work on the Contract, the Contractor shall provide the Engineer with telephone numbers of his authorized personnel and the order in which they are to be contacted. The Contractor shall provide the Engineer with an updated list as needed to ensure accuracy.

The Engineer will provide the Contractor with a list of Department representatives and the order in which they are to be contacted. The Engineer will update the list as needed to ensure accuracy.

When contacted by emergency services such as the Police, Fire Departments, or representatives of Disaster Services, concerning an emergency situation, the Contractor shall cooperate with the request and respond as necessary.

51.2.14.3 Vehicle Markings

The Contractor shall ensure that the Contractor's name and contact telephone number are prominently displayed on the sides of all of his vehicles involved in the Work.

51.2.15 COMPLIANCE WITH LAWS AND REGULATIONS

The Contractor shall, in the performance of the Work, comply with the requirements of the laws in force in Papua New Guinea.

In performing the Work, the Contractor shall comply with all applicable statutes, regulations, by-laws, and lawful orders and directives of the respective governmental authorities having jurisdiction. The Contractor shall obtain any permits, licenses, approvals or consents necessary for the Work or the Materials, and shall pay any tax, levy, fee or other like charge required to be paid in order for the Contractor to perform the Work or for the Department to use the Materials.



51.2.16 PAYMENT BY WEIGHT

51.2.16.1 Supply of Platform Weigh Scales and or other Weigh Scales

When payment by weight is specified, the Engineer will determine whether or not a platform weigh scale is required.

If the Engineer requires the use of a platform weigh scale and a suitable platform or silo weigh scale exists within reasonable proximity of the worksite or haul route, such a weigh scale would normally be used. In these situations the Department will compensate the Contractor for any additional costs incurred in obtaining access to and using the weigh scale. Such costs will be established to the mutual agreement of the Engineer and the Contractor, prior to commencement of the Work.

If the Engineer requires the use of a platform weigh scale and a suitable platform or silo weigh scale does not exist in the area, the Engineer may require the Contractor to provide a platform weigh scale. In these situations, the Department will compensate the Contractor for the supply and use of a platform weigh scale (including a scale house and scaleperson) as a Variation to the Work.

If the Engineer does not require the use of a platform weigh scale, the Contractor shall have the option of having measurements made in cubic metres and converted to tonnes using the applicable Department specified conversion factor or, providing and using any type of scale which is capable of accurately weighing the material. In these situations, if a scale is used, the costs associated with the provision and use of the scale will be considered incidental to the Work and will not be paid for separately.

51.2.16.2 Operating Standards for Platform Weigh Scales and other Weight Scales

All platform weigh scales and any other weight scales used in the Work must be certified by the National Institute of Standards and Industrial Technology (NISIT) or by a testing organization certified or recognized by NISIT. The most recent certificate must be displayed on the weigh scale at all times. In the event a certified weigh scale is modified in any way, the Contractor shall ensure the scale is re-certified prior to being used.

Prior to use for work identified in a Contract and in each instance that a certified weigh scale is moved and set up, the Engineer may require the Contractor to "test" the weigh scale using the procedures established by NISIT. The purpose of this "test" is to ensure the weigh scale conforms to the current standards required by NISIT. The Engineer reserves the right to be in attendance during the entire testing process. When such testing has been ordered, the Contractor shall provide the Engineer with reasonable notice of the date and time of the "test".

The cost of testing the weigh scale will be considered incidental to the Work and will not be paid for separately.

51.2.16.3 Verification of the Accuracy of a Weigh Scale

Regardless of the type of weigh scale used the Engineer may, when he deems it necessary, require the Contractor to verify the accuracy of the weigh scale at any time. The Contractor shall provide all equipment, facilities and labour required to verify the accuracy of the weigh scale and shall cooperate fully in the process. Any costs incurred by the Contractor in the verification process will be paid as a Work Variation if the weigh scale proves to be accurate, otherwise the Contractor shall bear the cost of verification.

51.2.17 PAYMENT BY VOLUME

When payment by volume is specified, quantities will be based on truck box measurement unless otherwise specified.

When the Work involves the use of existing stockpiles and the quantity of Material is known through prior measurement or calculation, the Engineer may direct that the previous quantity be used for calculation of payments.



51.2.18 RECORDS OPEN FOR INSPECTION

The Contractor's payrolls, time records, invoices, statements, and any other financial documents, data or records which may, in the Engineer's opinion, have any relation to the Contract shall at all times be open for inspection and copying by the Engineer. The Contractor shall assist the Engineer in every possible way in this inspection.

51.2.19 DATA FOR INFRASTRUCTURE MANAGEMENT SYSTEM

When Work is performed on any highway appurtenance, the Contractor shall furnish appurtenance inventory data in a format compatible with the Department's Road Asset Management System (RAMS). Generally, the data shall be submitted on forms provided by the Department and shall be provided on but not be limited to, the following appurtenances: signs, lighting facilities, culverts, line painting, pavement messages, guardrail, traffic signals, crash barriers, rumble strips and other miscellaneous items.

51.2.20 OWNERSHIP OF DATA

Data and information provided by the Department to the Contractor during the performance of the Work shall remain the property of the Department.

Copyright and ownership of all data collected and provided, and in all drawings prepared by or on behalf of the Contractor during the performance of the Work shall become the sole property of the Department.

51.2.21 CONFIDENTIALITY

The Contractor shall treat data and information concerning the Department or third parties, or the business activities of them, as confidential and not disclose, copy, use, or permit the use of it at any time or in any way, other than for the purpose of performing this Contract. The Contractor shall not communicate any matters concerning the Work to any member of the public or any news medium, whether the press or radio or television, without the prior written consent of the Engineer.

The Contractor shall limit the disclosure of confidential information to those persons to whom such disclosure is strictly necessary for the performance of the Contract and shall ensure that those persons are bound by obligations of confidentiality equal to those contained in this section.

The Contractor shall not use the name of the Department in whole or in part, in publicity releases, advertising or promotion of the Contractor's business without the Department's written consent.

51.2.22 FACILITIES

The Contractor is ultimately responsible to provide all facilities and stockpile sites necessary to meet the requirements of the Contract.

In all facilities or sites including those provided by the Contractor, the Contractor shall conduct all activities in compliance with the Environmental Act 2000.

51.2.23 DISPOSAL SITES

The Contractor shall be responsible for identifying and using proper disposal sites, including obtaining all necessary approvals from the Engineer and appropriate jurisdiction or authority. In addition, when requested by the Engineer, the Contractor will provide information on the disposal site such as location and haul distance to the site.



51.2.24 EQUIPMENT AND MATERIALS

51.2.24.1 Equipment

The Contractor shall supply all equipment necessary to complete the Work. When specific types of equipment are required, such equipment will be specified in the Technical Specifications.

All equipment supplied must meet the required mechanical safety standards for the applicable acts and regulations.

51.2.24.2 Materials

The Material requirements specified in the respective Technical Specifications refer to the most commonly used products. In the event that the Contractor and the Engineer agree to the use of a product/material which was not specified at the time of Contract award, the Contractor and Engineer may negotiate a new unit price for the Work.



52.0 SAFETY QUALITY AND ENVIRONMENTAL SPECIFICATIONS

- 52.1 TRAFFIC CONTROL
- 52.2 WORK SAFETY
- 52.3 ENVIRONMENT PROTECTION
- 52.4 QUALITY CONTROL



52.1 TRAFFIC CONTROL AND TEMPORARY SIGNING

52.1.1 GENERAL

The Work consists of accommodating traffic through work areas and the installation, maintenance and removal of temporary signing which is specifically related to construction/maintenance operations and which is generally removed when the Work is completed or the situation returns to normal. The Contractor shall implement traffic accommodation controls on all aspects of the Work to ensure the safety of the workers and the motoring public and all signing shall be provided in accordance with the Department's Safety Guidelines Policy and Safe Traffic Control at Road Works manual.

Some maintenance work has a minimal impact on traffic flow and therefore may not require full signing and/or traffic accommodation under all circumstances. Examples which may fall into this category are:

- removal of isolated debris (tire treads and other small objects);
- removal of small animals from the roadway;
- spontaneous filling of sporadic potholes (involving at least two workers);
- washing delineators or signs; and
- other work which is entirely off the roadway surface

The Engineer will identify Work in this category. However, agreement that complete signing is not necessary, does not release the Contractor from the obligation to keep the work site safe for both workers and the travelling public.

52.1.2 STANDARDS

Conform to the following Standards and Publications unless specified otherwise:

AS 1742.3-2002	Manual of uniform traffic control devices – Traffic control devices for works on roads
AS 1742.10-1990	Manual of uniform traffic control devices – Pedestrian control and protection
DOW STC-RW	Safe Traffic Control at Road Works – Manual
DOW STC-FG	Safe Traffic Control at Road Works – Field Guide Manual
AP-G30/02	Road Safety Audit (2 nd Edition)

52.1.3 HOURS OF WORK

All Work within the right-of-way shall be performed during daylight hours only, unless it is provided otherwise in the Technical Specifications or unless adequate lighting exists which provides visibility of at least 700 metres and prior approval of the Engineer is obtained. Emergency work may also be carried out during hours of darkness with the approval of the Engineer.

No Work shall be performed within the right-of-way when the visibility is less than 700 metres, unless otherwise specified in the Technical Specifications or approved by the Engineer.

52.1.4 THIRD PARTY ACCIDENT REPORTING

The Contractor shall immediately notify the Engineer of any accidents involving his or his sub-contractors vehicles or equipment or that occur in a Work Zone, and which involve a fatality, serious personal injury,



or 3rd party property damage in excess of K1,000 or as specified in the Motor Traffic Act, or any act or regulation that replaces the Motor Traffic Act Provisions. The Contractor shall investigate the accident (including those of his sub-contractors) and complete a detailed accident report in a form satisfactory to the Engineer within 72 hours of knowledge of the accident. (Report to include photos, details of site conditions, records of signs, etc.).

52.1.5 MATERIALS

The Contractor shall supply signs, sign posts, weighted stands and any other materials necessary to complete the Work.

Temporary signs shall conform to required standards, in shape, colour and size. The orange portion of all signs, barricades and other traffic control devices shall be fully reflectorized using High Brightness, Retroreflective, Non-Metallized, Prismatic Sheeting Material which incorporates durable, transparent, fluorescent pigment and meets the requirements as shown in the Department's Recognized Products List. All other colours of sheeting material shall be Type III, High Intensity meeting the requirements of ASTM D4956. Standards for colours, shapes and sizes are referenced in the Standards for Signs.

52.1.6 TRAFFIC CONTROL PLAN

When required by the Contract or Engineer and prior to commencement of the Work, the Contractor shall prepare Traffic Control Plans detailing the measures he proposes for the Control of traffic throughout work zones for the various highway maintenance activities. Each Traffic Control Plan shall be in compliance with the Department of Works Safety Guidelines, Safe Traffic Control at Road Works Manual and Field Guide, AS 1742 and shall be subject to the Engineer's approval.

The Engineer may allow the use of a single Traffic Control Plan for multiple occurrences of similar highway maintenance activities. Typically, this may be appropriate in situations where there are no significant differences in the site specific issues to be addressed for each occurrence of the activity.

The various maintenance activities for which Traffic Control Plans will be required and the timing of the submission of the Plans by the Contractor will be determined by the Engineer at the pre-commencement meeting.

The Contractor's Traffic Control Plan shall include but is not limited to the following:

- (a) a general description of traffic control measures and procedures including the provision and maintenance of detours, materials, equipment and Traffic Controllers;
- (b) graphic plans of each work sector, showing the location of the work and traffic control measures, including the separation of public traffic, construction traffic and the work area, signage configurations and locations and traffic control points, for each work situation or scenario;
- (c) written confirmation of the methods or procedures being used by the Contractor to address specific safety related issues or situations within each work zone.
- (d) description of the Contractor's traffic control organization with clear job descriptions, functions, responsibilities, authority, record keeping and reporting procedures;

The Contractor shall attach a clear and measurable cost breakdown for the provision and implementation of his traffic control plans to the Bill of Quantities, and post the total cost on the Bill of Quantities.

52.1.7 PROCEDURES

52.1.7.1 General

Work shall not commence until all necessary traffic control devices and/or detours are in place.

The Contractor shall make suitable provisions, including the use of detours, to accommodate all vehicular and pedestrian traffic safely with a minimum of inconvenience through or around the Work. The



Contractor shall provide, install, maintain and protect traffic control devices such as signs, barriers, fences, lights, and such other methods, including the use of flagpersons, as may be required. Traffic control devices shall be moved and kept as close to the work area as practical, as the Work proceeds.

The Contractor shall remove or cover all traffic control devices when they are not essential for the safe control of traffic.

The Contractor shall coordinate traffic control measures with those of other forces at or adjacent to the Work, as required, to accommodate traffic safely and conveniently. This shall not relieve the Contractor of the responsibility for the safe control of traffic over the whole of the Work.

52.1.7.2 Signing

When signs require frequent moves, portable type signs, mounted on weighted stands, may be used. Portable signs shall be placed on the shoulder of the road such that the face of the sign is fully visible to oncoming traffic and the bottom of the sign is not less than 0.3 m above the road surface. The stands shall be securely weighted and erected against being blown over by prevailing winds or gusts from passing vehicles.

Non-portable signs shall be conspicuously posted, and erected at right angles to the roadways, with the bottom of the sign at a height of 1.5 m above the roadway surface, and not less than 2 m nor more than 6.0 m from the nearest traffic lane.

During periods of darkness, signs indicating hazardous conditions and signs requiring increased attention shall be marked with flashers.

Temporary signs shall be erected and maintained in accordance with the latest edition of the Department's Safety Guidelines, Safe Traffic Control at Road Works Manual and Field Guide.

The Department may issue updates for specific types of Work not shown in the Safety Guidelines. In the interim, the Contractor shall propose a typical signing drawing to be reviewed and approved by the Engineer and this configuration will be followed for the duration of the Work.

Poorly maintained, defaced, damaged or dirty construction signs shall be replaced, repaired or cleaned without delay. Special care shall be taken to ensure that construction materials and dust are not allowed to obscure the face of a sign.

Objects within or immediately adjacent to the roadway which constitute a hazard to traffic shall be identified with appropriate safety hazard markers.

"STOP" signs shall be installed on all subsidiary roads (local, district, municipal, service or approach) intersecting a Detour Route.

When a reduction in speed is required, signs shall be posted as indicated in the Department's Safety Guidelines, Safe Traffic Control at Road Works Manual and Field Guide or relevant Australian Standards. Signs shall indicate limits as ordered by the Engineer.

All temporary signs shall be removed as soon as possible after the project is completed.

52.1.7.3 Flagpersons

When maintenance operations or work zone conditions cause interruption, delay or hazard to the travelling public, flagpersons shall be continuously maintained for the direction and control of traffic. The Contractor shall ensure that flagpersons are instructed in and use proper traffic control procedures appropriate for the prevailing conditions. Flagpersons shall be properly trained by an instructor recognized by the Road Safety Council as qualified for this purpose. The Contractor shall produce proof of training to the Engineer upon request.

Flagpersons shall be dressed in clean white uniforms or coveralls, orange hard hats and fluorescent red-orange overvests for maximum visibility, and shall be equipped with the traffic control paddles specified in the Department's Safety Guidelines, or the relevant Australian Standards. The fluorescent red-orange overvests shall have 50 mm wide reflective yellow striping with a minimum total length of 60 cm on the front and 120 cm on the back.



During hours of darkness, flagpersons shall be additionally equipped with a red signal hand-light of sufficient brightness to be clearly visible to approaching traffic and flagging stations shall be illuminated by overhead lighting.

52.1.7.4 Detours

Subject to the approval of the Engineer, detours may be used to carry traffic around the Work.

When traffic is diverted entirely off the right-of-way, the Contractor shall establish or construct and maintain a detour that shall be complete with signs at every intersection in accordance with the Department's Safety Guidelines, Safe Traffic Control at Road Works Manual and Field Guide and the relevant Australian Standards and field guides.

When the Contractor is directed by the Engineer to use a local road as a detour, the Contractor shall obtain approval from the local level or provincial government to use the detour, and maintain and restore the detour to a standard at least equivalent to its original condition. This will include regravelling if required. The Contractor will be compensated for this Work at the appropriate bid prices. The Engineer will be the final authority on the condition of the detour.

When the Contractor chooses to use a local road as a detour, the Contractor shall obtain approval from the local level or provincial government to use the detour and maintain and restore the detour to the condition required by the local level or provincial government. The local level or provincial government will be the final authority on the condition of the detour.

52.1.7.5 Removal and Salvage of Existing Signs and Guideposts

All existing signs and guideposts, which are to be removed in the prosecution of the Work shall be carefully salvaged by the Contractor and maintained in a condition suitable for reinstallation. Critical signs necessary for the protection of traffic, such as Stop or Yield signs shall be maintained in place.

52.1.8 MODIFICATIONS TO TEMPORARY SIGNING

The Contractor shall be totally responsible for the supply and proper placement of temporary construction signs. However, in the case of potential danger to the travelling public or other circumstances where the Engineer determines that signing is inadequate, the Engineer will require changes to the Contractor's operations to remedy the situation. These changes may involve the use of different types and/or sizes of signs, modifying the number or locations of signs, and any other modifications or additions required to protect the safety of the travelling public.

52.1.9 DAILY RECORDING OF TEMPORARY SIGNING

When required by the Engineer, the Contractor shall record the location of all temporary signs and other traffic control devices. When such recording is required, it shall be performed each day and as the work zone changes. The Contractor shall record this information on a form suitable to the Engineer and shall submit the information to the Engineer upon request.

52.1.10 COMPLIANCE

In cases where the Contractor is not in compliance with the specifications and, in the opinion of the Engineer there is imminent danger to the travelling public, the Engineer has the authority to order the immediate suspension of Work. Such orders must be made in writing.

In other cases where the Contractor is not in compliance with the specifications but, in the opinion of the Engineer the infraction is not causing imminent danger to the travelling public, the Engineer will use the following escalating process to address the situation:

- Issue verbal instructions requiring the Contractor to correct the infraction;
- Issue a written warning instructing the Contractor to correct the infraction;



- Issue a written order instructing the Contractor to suspend Work until the infraction is corrected to the satisfaction of the Engineer.

52.1.11 MEASUREMENT AND PAYMENT

The unit measure for the **approval of the Contractor's Traffic Control Plan** shall be a lump sum item on the Bill of Quantities. Payment will be made on approval of the Contractor's Traffic Control Plan by the Employer's Engineer.

The unit of measurement for the **implementation and maintenance of Traffic Control Measures** shall be a lump sum item on the Bill of Quantities. Payment will be made upon the Engineer's certification of the satisfactory provision and maintenance of detours, materials, equipment and traffic controllers for traffic control, per work sector as per the Contractor's conforming Traffic Control Plan, at the completion of the works in each work sector.

When the Engineer directs that an unplanned detour road be constructed, the costs of constructing and maintaining the temporary detour and for any required gravelling or dust control of the detour surface will be paid for at the applicable unit prices bid for the type of Work performed. If there are no applicable unit prices for the Work the detour surface will be paid for at the applicable Dayworks unit prices bid by the Contractor.

When the Contractor uses a detour which has not been requested by the Engineer, these costs will be the responsibility of the Contractor and no payment will be made.



52.2 WORK SAFETY

52.2.1 GENERAL

The Contractor shall familiarize himself, his staff and his subcontractors with the terms of the Department of Works Safety Guidelines, Safe Traffic Control at Road Works manual and the Industrial Safety Health and Welfare Act and Regulations to ensure complete understanding with respect to the responsibilities given and compliance required. By signing the Contract Agreement, the Contractor acknowledges that he is and assumes all of the responsibilities and duties as an employer and Contractor as defined by the Department's Safety Guidelines, Safe Traffic Control at Road Works manual and the Industrial Safety, Health and Welfare Act, and that he shall, as a condition of the Contract, comply with the Department's Safety Guidelines, Safe Traffic Control at Road Works manual and the Industrial Safety, Health and Welfare Act and the regulations thereunder.

In the event that the work sites of 2 or more Prime Contractors of the Department coincide, it shall be the responsibility of the Prime Contractor of this Contract to liaise with all other prime Contractors and jointly develop a health and safety system or process for the affected work site. If 2 or more Prime Contractors of the Department cannot agree on a process or system that addresses the safety concerns of all parties, work at the affected work site shall cease and the matter shall be referred to the Engineer or his representative. Upon review, the Engineer will decide which Prime Contractor shall be responsible for resolving the disputed safety issue. Such decision shall be final and binding upon all Prime Contractors.

The Prime Contractor shall, to the extent required by the Department's Safety Guidelines, Safe Traffic Control at Road Works manual and the Industrial Safety, Health and Welfare Act and Regulations, establish and maintain a health and safety system or process to ensure compliance with the Act by his employees, agents and subcontractors/owner operators.

52.2.2 STANDARDS

Conform to the following Standard and Publication unless specified otherwise:

- a. Department of Works Safety Guidelines, Safe Traffic Control at Road Works Manual and Field Guide
- b. Industrial Safety, Health and Welfare Act

52.2.3 SAFETY PREQUALIFICATION

Unless provided with a special dispensation by the Employer's Representative or his delegated representative, Contracts will be awarded only to Contractors who, prior to the time fixed for opening of bids, have achieved accreditation/recognition or have enrolled in a safety certification program relevant to road and bridge works and recognized by Safety PNG. Contractors who have not yet achieved accreditation in such a program, but have a "Temporary Letter of Certification" (T.L.C.) from Safety PNG, must achieve full certification within 6 months of signing the Contract.

The Employer will verify the Contractor's compliance with this requirement through Safety PNG. It is the Contractor's responsibility to ensure that his registration in the program is properly documented with the Safety PNG, and the Department will assume no liability for errors or omissions by Safety PNG in this regard.

The Contractor shall also ensure to his satisfaction that any subcontractors/owner-operators are able to comply with all health and safety requirements before commencing the Work. The Contractor shall assume all responsibility for his subcontractors/owner-operators, with regard to health and safety compliance



52.2.4 WORK SITE HAZARDS & SAFETY PROGRAMME

The Contractor has the responsibility to identify work site hazards and develop a safety programme comprising the Contractor's operational occupational safety policies, procedures and plans specific to the Work to ensure the safety of every person at the construction site and of the public travelling through the site. The Contractor shall provide copies of these safety policies, procedures and plans to the Engineer for approval, prior to the commencement of the Work.

The safety programme shall be in compliance with the **Industrial Safety, Health and Welfare Act** of Papua New Guinea and the **Department of Works Safety Guidelines, Safe Traffic Control at Road Works Manual and Field Guide**, and shall include but is not limited to the following:

- (a) Contractor's Safety Policy and procedures;
- (b) description of company's organization structure, identifying supervisory and safety personnel, job descriptions, responsibilities, authority and functions;
- (c) programme for the dissemination of safety information, material safety data and the conduct of safety awareness, on site from the start date to the intended completion date;
- (d) programme for the regular safety inspection of all plant and equipment;
- (e) identification of all work activities on site with clear descriptions of safety procedures and measures to be implemented during each work activity, including the use of necessary protective equipment for each work activity;
- (f) description of emergency procedures, including responses to accidents and injury, emergency evacuation plans, the supply, use and locations of First Aid Kits, provisions for rescue and other emergency equipment and personnel, as may be required by the Engineer;
- (g) description of Fire prevention measures and the supply and location of Fire Fighting equipment;
- (h) description of the safety programme administrative arrangements, including the flow of and filing of communications and correspondences, record keeping, investigating and reporting procedures for incidents resulting in death, injury, loss of work-time, damage to equipment and or property.

The Contractor shall attach a clear and measureable cost breakdown for the provision and implementation of its safety programme to the Bill of Quantities and post the total cost on the Bill of Quantities.

If the Department of Labour and Employment or their authorized representatives conduct a work site inspection that results in orders being issued to the Contractor, the Contractor shall immediately supply copies of these orders to the Engineer.

The Engineer may suspend Work in cases of recognized imminent danger or when the Contractor fails to comply with safety orders issued, or to rectify previously identified work site hazards. The Engineer's interpretation of a work site hazard will be considered final in all cases.

52.2.5 ACCIDENT INVESTIGATIONS

In the event of an injury or accident as defined by the Industrial Safety Health and Welfare Act and regulations, involving employees of the Contractor or his subcontractors, the Contractor shall immediately notify the Engineer and conduct an accident investigation in accordance with Section 13 of the Occupational Health and Safety Act. In addition, the Contractor shall supply a copy of this investigation report to the Engineer within 72 hours of the occurrence.

52.2.6 SAFETY MEETINGS

Upon Contract award, a pre-commencement meeting will be conducted by the Engineer. The Contractor shall ensure his authorized representative or project supervisor, the Contractor's designated safety representative and a representative from each subcontractor named in the Contract are in attendance.



While the Work is in progress, the Contractor's project supervisor shall conduct safety meetings prior to the commencement of Work on each major Work phase or monthly, whichever occurs first. The Engineer or his designate shall be invited to attend.

52.2.7 SCAFFOLDING, FALSEWORK AND TEMPORARY PROTECTIVE STRUCTURES

All scaffolding, falsework and temporary protective structures shall be designed for the loads they are required to carry. They shall be engineered and designed for safety in all respects, and shall meet the requirements of the Industrial Safety, Health and Welfare Act. Drawings shall be stamped by a Professional Engineer, registered or eligible for registration in Papua New Guinea. The Contractor shall verify all components are as shown on the drawings before use. A copy of these drawings must be retained on site at all times the system is in use.

52.2.8 PRECAUTIONS AS TO FIRE

The Contractor shall, at his own expense, take special precautions to prevent or extinguish uncontrolled fire occurring at or near the work site which is a result of the Contractor's performance of the Work.

52.2.9 MEASUREMENT AND PAYMENT

The unit measure for the **approval of the Contractor's safety programme** shall be a lump sum item on the Bill of Quantities. Payment will be made on approval of the Contractor's safety programme by the Employer's Engineer.

The unit of measurement for the **implementation of the Contractor's safety programme** shall be a lump sum item on the Bill of Quantities. Payment will be made upon the Engineer's certification of the satisfactory performance of each safety item, based on the Contractor's costing for each safety item.



52.3 ENVIRONMENT PROTECTION

52.3.1 GENERAL

The work consist of the provision and implementation of an environment protection plan on road and bridge maintenance works.

52.3.2 STANDARDS

Conform to the following Standard and Publication unless specified otherwise:

- a. Environment Act, 2000;
- b. Department of Works Environment Guidelines;

52.3.3 POLLUTION CONTROL

The Contractor shall conduct his operation in accordance with all current environmental legislation; federal, provincial and local bylaws, and other legislation that may affect the conduct of operations and the Department of Works Environment Guidelines.

The Contractor shall become familiar with the applicable legislation, regulations and requirements.

The Contractor shall obtain all necessary approvals and permits and provide copies to the Engineer.

The Contractor shall remove and dispose of any inert solid waste resulting from the production of asphalt concrete pavement, concrete or soil cement to the satisfaction of the Engineer.

The Contractor shall clean up any waste arising from his Work which may cause pollution. Should the Contractor fail to do so, the Engineer may, without notice, arrange the clean-up and restoration of the site at the expense of the Contractor.

52.3.4 CLEAN WORK SITE

During the course of the Work, the Contractor shall keep the work site in a neat and tidy condition satisfactory to the Engineer. The Contractor shall upon the completion of the Work, remove all temporary structures and clear away all rubbish, surplus, and waste material remaining at or near the work site and leave the area in a neat and tidy condition satisfactory to the Engineer. If these requirements are not met, the Engineer may give written notice to the Contractor requiring him to remedy the situation. If the Contractor fails to remedy the situation within 14 days of receipt of the notice, the Engineer may cause the situation to be remedied and may deduct the cost thereof from any money owing to the Contractor.

52.3.5 ENVIRONMENT PROTECTION PLAN

The Contractor shall prepare and implement an Environment Management Plan on all sites related to the Works. The Environment Management Plan shall subject to the Engineer's approval and be in compliance with the Papua New Guinea **Environment Act 2000** and the **Department of Works Environment Guidelines** and shall include but is not limited to the following:

- (a) Contractor's Environment Policy and procedures;
- (b) description of company's organization, identifying supervisory and personnel responsible for implementation of its Environment Management Plan, including organization structure and job descriptions showing functions, responsibilities and authority;



- (c) programme for the dissemination of Environment Protection information and the conduct of Environment awareness, on site and in neighbouring communities from the start date to the intended completion date;
- (d) programme for the regular environment compliance inspection of all plant and equipment;
- (e) identification of all work activities and determination of possible environment impacts of the activities at all work locations, including but not limited to: road works, camps, quarry(ies), stock-pile and storage sites, fuel dumps, spoil heaps and disposal dumps, etc;
- (f) description of community consultations and local social issues;
- (g) description of procedures and environment protection measures to be implemented during each work activity, including but not limited to: erosion and sediment control, disposal of storm-water runoff, contaminant spill prevention, water sources protection; protection of wildlife, wild-life habitats, conservation areas, archaeological and burial sites, Rehabilitation of work sites, including camps, quarries, dump and storage sites, etc., and dust, noise and vibration mitigation measures;
- (h) description of emergency procedures and measures for hazardous material spills, the supply, storage, maintenance, and use of Emergency Spill Kits, as may be required by the Engineer;
- (i) description of procedures and environmental measures for the disposal of excess and waste materials and the decommissioning of work sites, camps and quarries;
- (j) plans showing the type and location of environment protection measures in relation to road works, camp sites, quarries, stockpiles, spoil heaps and waste disposal sites, water sources, archeological, burial and any conservation sites, fuel and oils storage, workshops, plant and equipment storage sites, etc.;
- (k) description of the Environment Management Plan administrative arrangements, including the flow of and filing of communications and correspondences, record keeping and reporting procedures.

The Contractor shall attach a clear and measurable cost breakdown for the implementation of its Environment Management Plan to the Bill of Quantities and post the total cost on the Bill of Quantities.

52.3.6 MEASUREMENT AND PAYMENT

The unit measure for the approval of the “**Contractor’s Environment Management Plan**” shall be a lump sum item on the Bill of Quantities. Payment will be made on approval of the Environment Management Plan by the Employer’s Engineer.

The unit of measurement for the “**Implementation of the Contractor’s Environment Management Plan**” shall be a lump sum item on the Bill of Quantities. Payment will be made upon the Engineer’s certification of the satisfactory performance of each environment protection item, based on the Contractor’s costing for each Environment Protection item.



52.4 QUALITY CONTROL

52.4.1 GENERAL

The work consist of the provision and implementation of a quality control plan on road and bridge maintenance works.

52.4.2 STANDARDS

Conform to the following Standard and Publication unless specified otherwise:

Department of Works Quality Guidelines;

52.4.3 CONTRACTOR'S QUALITY CONTROL (QC) PROGRAMME

The Contractor shall prepare and implement a quality control programme, to ensure compliance to the work specifications and drawings. The quality control programme shall be in compliance with the **Department of Works Quality Guidelines** and shall include but is not limited to the following:

- (a) Contractor's Quality Policy and procedures;
- (b) Description of the company's and project organization, identifying personnel responsible for the implementation of its Quality Control (QC) Plan, organization structure and job descriptions detailing QC personnel qualifications, experience, authority, responsibilities and functions;
- (c) Identification of the materials and workmanship to be inspected and tested and arrangements for material storage areas, the management and maintenance of storage areas and procedures for receiving and shipping materials;
- (d) Identification of inspections and tests to be conducted, the methods and frequency for tests and inspections, as may be specified in the Specifications or by the Engineer and any external organizations, laboratories or subcontractors, to be employed in the inspections and or testing;
- (e) The acceptance criteria and standards to be applied for inspection and testing of materials and workmanship and the corrective action in the event of non-compliance, as may be specified in the Specifications or by the Engineer;
- (f) Description of the QC system administrative arrangements, including the flow of and filing of communications and correspondences, record keeping and reporting procedures;

The Contractor shall attach a clear and measureable cost breakdown for the implementation of its quality control programme to the Bill of Quantities and post the total cost on the Bill of Quantities.

52.4.4 MEASUREMENT AND PAYMENT

The unit measure for the provision of the **"Contractor's approved quality control programme"** shall be a lump sum item on the Bill of Quantities. Payment will be made on approval of the quality control programme by the Employer's Engineer.

The unit of measurement for the **"Implementation of the Contractor's quality control programme"** shall be a lump sum item on the Bill of Quantities. Payment will be made upon the Engineer's certification of the satisfactory performance of each QC item, based on the Contractor's costing for each QC item.



53.0 PAVEMENT MAINTENANCE SPECIFICATIONS

- 53.1 EARTHWORKS
- 53.2 PIT-RUN GRAVEL
- 53.3 GRANULAR BASE COURSE
- 53.4 FORMATION CLEARING GRUBBING AND STRIPPING
- 53.21 SEALED PAVEMENT CRACK SEALING
- 53.22 SEALED PAVEMENT POTHOLE PATCHING
- 53.23 SEALED PAVEMENT SLURRY SURFACING
- 53.24 SEALED PAVEMENT RECONSTRUCTION PATCHING
- 53.25 SEALED PAVEMENT REGULATION PATCHING
- 53.26 ASPHALT PAVEMENT SURFACE MAINTENANCE
- 53.27 SEALED PAVEMENT SPRAY SEALING FOR MAINTENANCE
- 53.28 SEALED PAVEMENT REPAIR OF EDGE BREAK
- 53.29 MAINTENANCE OF UNSEALED SHOULDERS
- 53.41 MAINTENANCE AND PREPARATION OF GRAVEL SURFACED ROADS
- 53.42 SPOT GRAVELLING
- 53.43 GRAVEL SURFACING (SHEETING)
- 53.44 GRAVEL PAVEMENT POTHOLE PATCHING
- 53.61 ROADWAY AND RAISED MEDIAN CLEANING
- 53.62 SAW CUTTING OF ASPHALT CONCRETE PAVEMENT
- 53.63 PAINTED ROADWAY LINES
- 53.64 RAISED PAVEMENT MARKERS



53.1 EARTHWORKS

53.1.1 GENERAL

The Work consists of excavating subgrade soil and/or granular materials from gravel surface roadways or approaches generally for roadway strengthening. The excavated materials shall be salvaged, stockpiled and reused as backfill or disposed of as directed by the Engineer.

This specification does not apply for excavation and backfill associated with the installation or removal of culverts or pavement patching.

53.1.2 STANDARDS

Conform to the following Standard and Publication unless specified otherwise:

- AS 1289 Methods of Testing Soils for Engineering Purposes.
- NTTM Northern Territory Materials Testing Manual.

53.1.3 MATERIALS

Use the best locally available material.

Use fill material, whether cut or borrow, that is free of organic matter and has a minimum soaked CBR at 90% MMDD of 10%, at 2.5 mm penetration, and a plasticity index between 2% and 15%.

53.1.3.1 Standard Fill

Conform to the following properties:

CBR 4 day soaked at 95% MMDD at 2.5 mm penetration:	15
Maximum Particle Size:	100
Plasticity Index:	2% - 15%

53.1.3.2 Select Fill

Select fill shall be comprised of gravel, decomposed rock or broken rock, free from organic matter and lumps of clay.

Conform to the following:

53.1.3.2.1 Grading:

AS SIEVE (mm)	% PASSING (DRY WEIGHT)
75.00	100
9.50	30 - 100
2.36	15 - 65
0.075	5 - 25

- CBR, 4 day soaked at 95% MMDD at 2.5 mm penetration: 30 minimum.
- Plasticity Index: 2 - 15% maximum.
- Linear Shrinkage: 2 - 6%.



53.1.4 PROCEDURE

53.1.4.1 General

The Contractor shall excavate material to the widths and depths specified by the Contract. The excavated material shall be salvaged and stockpiled for use as backfill material or disposed of as determined by the Engineer.

Backfilling operations shall commence immediately following the completion of the excavation. If the salvaged material is used, it shall be placed and compacted in the excavated area to the specified thickness. Any other granular material required for backfilling shall be produced and placed in accordance with the applicable specifications.

53.1.4.2.1 Earthworks In Cut

Operations necessary for excavation, irrespective of the type of material and subsurface conditions, including:

- working cuttings so that material meeting standard fill requirements is used for the subgrade;
- disposal of excess excavated material;
- compaction of material below the subgrade surface; and
- shaping and trimming of formation within cuttings.

53.1.4.2.1.1 Rock

- Obtain agreement from the Engineer to the extent of the excavation.
- Excavate rock encountered in the subgrade, formation, or drain.
- Avoid forming pockets of shattered material below the level of the excavation.
- Remove all loose material.
- Trim the excavation to shed water.
- In subgrade, replace excavated material with select fill compacted to 95 per cent relative compaction.

53.1.4.2.1.2 Unsuitable Material and/or Weathered Rock

- Obtain directions from the Superintendent before works commence.
- Excavate unsuitable material and/or weathered rock encountered in the subgrade, formation, or drain.
- Avoid forming pockets of shattered material below the level of the excavation.
- Remove all loose material.
- Trim the excavation to shed water.
- *In subgrade:* Replace excavated material with select fills compacted to 95 per cent relative compaction.
- Earthworks in fill includes winning, hauling, placing and compacting material on all prepared areas including:
 - Scours and Washouts
 - General Filling, includes holes, pits and other depressions.



53.1.4.2.2.1 Benching

Cut a bench at the toe of the lower side batter when natural surface inclines at steeper than eight horizontal to one vertical.

Ensure the bench slopes downwards towards the centre line of the road and is 3 metres wide to provide a sound key for the toe of the fill.

Terrace the existing surface where side slopes are steeper than three horizontal to one vertical to provide a key for the fill.

53.1.4.2.2.2 Construction Methods

Fill by any of the "Compacted Layer", "Rocky Material" or "Rock Fill" method.

Select appropriate method(s).

53.1.4.2.2.2.1 COMPACTED LAYER METHOD

Use where material generally does not contain cobbles, boulders or broken rock.

- Deposit and spread the material in uniform level layers to a maximum thickness of 250 mm loose measurement for the full width of fill.
- Compact each layer to the specified compaction (refer Table - Dry Density Ratios for Conformance) before placing the next layer.
- Use standard fill for the subgrade.

53.1.4.2.2.2.2 ROCKY MATERIAL METHOD

Use where material contains some cobbles and boulders (maximum size 600 mm) with sufficient fines for the work to be free of voids.

- Break up rocks bridging between adjacent material to prevent cavities being formed.
- Maximum rock dimension: 600 mm or one-half the height of fill at the section where the rock is placed.
- Spread material in layers approximately equal to the maximum rock size.
- Work the rocky material in each layer until it is firm and unyielding.
- Construct to the bottom of the subgrade layer.

53.1.4.2.2.2.3 ROCKFILL METHOD

Use where material is predominantly cobbles or boulders with insufficient fines to fill voids.

- Place and work the material until interlock is achieved.
- Advance the fill by full width construction. Side dumping shall not be undertaken. The construction face shall be concave, with the shoulder face well in advance of the centre, except when filling in swamps or soft material when the advancing face ends shall be convex.
- Rock Dimensions.
- Maximum vertical dimension: one-third of the height of fill being placed.
- Maximum horizontal dimension: one-half of the height of the fill being placed.

Construct to 300 mm below the bottom of the subgrade layer. Within 300 mm of the bottom of the subgrade layer use the Compacted Layer Method or Rocky Material Method, with a maximum particle size of 150 mm.



53.1.4.3 Removal of Excess Material

Generally this work applies to the removal of unsuitable material such as silt, rubble, sand, debris dumped on windrows, floodways, pavements and drains.

Work does not include new works in cut, or heavy excavation of rock.

Haul and dump and spread excess material:

- Not less than 125 metres from the new road centre line, or
- To spoil dump sites specified. Clear site of organic material/topsoil prior to stockpiling material.
- Spread excess material, level to less than 2 metres high, and sheet with topsoil as specified.

Dumped material remains the property of the Principal.

Ensure dumps shall not dam surface water and streams or damage the works or other property.

Ensure dumping is not in streams and is away from streams to avoid being washed into streams during heavy rain or flooding.

53.1.4.4 Preparation and Maintenance of Subgrade Surface

Trim surface to the compliance tolerances specified free of depressions and free draining.

Maintain and repair any damage to the prepared surface prior to placing further material.

53.1.5 MEASUREMENT AND PAYMENT

53.1.5.1 Excavation

Measurement for excavating granular or subgrade materials will be in cubic metres based on the volume of excavated material in its original position.

Payment will be made at the unit price bid per cubic metre for "**Excavation**". This payment will be full compensation for excavating and salvaging or excavating and disposing of the material, and all labour, equipment, tools and incidental necessary to complete the Work.

Measurement and payment for the haul of excavated material designated for disposal will be made in accordance with **Specification 56.2: Hauling**.

53.1.5.2 Backfill

Measurement for backfilling excavations with salvaged material will be in cubic metres based on the volume of the backfill material in its final compacted position.

Payment will be made at the unit price bid per cubic metre for "**Backfill with Salvaged Material**". This payment will be full compensation for transporting, placing and compacting salvaged material, and all labour, equipment, tools and incidentals necessary to complete the Work.

Measurement and payment for new granular material used for backfilling excavations will be in accordance with Specification 53.2 – Pit-run Gravel or Specification 53.3 – Granular Basecourse.

53.1.6 WARRANTY

There is no warranty period for excavation Work. The warranty period for backfilling material shall be 1 year



53.2 PIT-RUN GRAVEL

53.2.1 GENERAL

The Work consists of placing pit-run gravel on gravel surface roadways or in excavations for pavement patching or culvert installations or at any other areas specified by the Contract.

53.2.2 STANDARDS

Conform to the following Standards and Publication unless specified otherwise:

PNGS 1185 Methods for Sampling and Testing Aggregates.

AS 1289 Methods of Testing Soils for Engineering Purposes.

53.2.3 MATERIALS

The Contractor shall pick up pit-run gravel from a source approved by the Engineer in accordance with the following requirements.

53.2.3.1 Gravel

Obtain material from sources of naturally occurring deposits.

Produce required properties by crushing, screening, mixing or other processes necessary.

Ensure particles are tough, durable and of a tightly binding nature free of organic or other deleterious matter.

Conform to the tables GRAVEL PARTICLE SIZES and GRAVEL PROPERTIES.

53.2.3.1.1 TABLE - GRAVEL PARTICLE SIZES

AS SIEVE (mm)	PERCENTAGE PASSING			
	1	2	3	4
75.0	100			100
37.5	80 - 100	100		80 - 100
19.0	50 - 80	70 - 100	100	60 - 100
9.5	35 - 65	50 - 80	70 - 100	50 - 95
4.75	25 - 50	35 - 65	50 - 80	40 - 80
2.36	15 - 40	25 - 50	35 - 65	30 - 65
0.425	7 - 20	10 - 30	15 - 35	20 - 50
0.075	3 - 13	4 - 16	6 - 20	5 - 25

The Contract will specify the appropriate grading numbers for the work. Generally Gradings: 2 or 3 are for Basecourse. Gradings: 1, 2, 3 or 4 are for Sub-base, and Grading 3 is for Shoulder.



53.2.3.1.2 TABLE - GRAVEL PROPERTIES

		SEALED BASE	UNSEALED BASE AND SHOULDER MATERIAL	SUB-BASE
1.	Liquid Limit (LL)	25% maximum (30%)	35% maximum	30% maximum
2.	Plasticity Index (PI)	1 - 6% (1 - 10%)	4 - 12%	1 - 10%
3.	Linear Shrinkage (LS)	0 - 3% (0 - 6%)	2 - 8%	0 - 6%
4.	PI x % passing 0.425 mm Sieve	180 maximum (300 maximum)	400 maximum	400 maximum
5.	California Bearing Ratio (CBR) 4 day soaked at 2.5 mm penetration at a relative density of	80 minimum 100% MMDD	50 minimum 95% MMDD	30 minimum 95% MMDD
6.	Los Angeles Abrasion (LAA) Loss	50 maximum	> maximum	60 maximum

53.2.3.2 Fine Crushed Rock

Manufacture from clean, hard durable rock free from clay, loam or other deleterious substances.

Conform to the tables CRUSHED ROCK SIZES and CRUSHED ROCK PROPERTIES.

53.2.3.2.1 TABLE - CRUSHED ROCK SIZES

AS SIEVE (mm)	PERCENTAGE PASSING
37.5	100
19.0	90 - 100
13.2	75 - 90
9.5	60 - 80
4.75	38 - 60
2.36	25 - 45
0.425	12 - 26
0.075	6 - 14



53.2.3.2.2 TABLE - CRUSHED ROCK PROPERTIES

1.	Liquid Limit (LL)	25% maximum
2.	Plasticity Index (PI)	1 - 6%
3.	Linear Shrinkage (LS)	3%
4.	Dust Ratio (DR) (% passing 0.075 mm)/(% passing 0.425 mm) x 100	25 - 50
5.	CBR, 4 day soaked at 100% MMDD at 2.5 mm penetration	100 minimum
6.	Los Angeles Abrasion (LAA) Loss: coarse grained rock fine grained rock	35 maximum 25% maximum
7.	PI x % passing 0.425 mm sieve	180 maximum

53.2.3.3 Sand Clay

A material complying with the following:

53.2.3.3.1 GRADING

AS SIEVE (mm)	PERCENTAGE PASSING
4.75	80 - 100
2.36	60 - 100
0.425	30 - 60
0.075	14 - 28

53.2.3.3.2 PROPERTIES

Plasticity Index: 20 maximum for sealed pavements
15 maximum for unsealed pavements.

Linear Shrinkage: 1% - 8%.

CBR, 4 day soaked at 95% MMDD
at 2.5 mm penetration: 50 minimum.

53.2.3.4 Supply to Stockpile

Clear the site.
Ensure the area is free draining.
Spread and compact a 75 mm thick layer of sub-base gravel to 95% relative compaction.
Trim stockpile to a uniform shape for ease of measurement.

53.2.4 PROCEDURE

Pit-run material shall be placed on the prepared area or in an excavation in a uniform manner and quantity, which will produce the required compacted thickness, shape and width specified by the Contract.

53.2.5 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer



53.2.6 MEASUREMENT AND PAYMENT

53.2.6.1 General

Measurement will be in cubic metres based on truck box measurement. Payment for hauling when specified will be made in accordance with **Specification 56.2 - Hauling**.

53.2.6.2 Contractor Supply of Pit-Run

Payment will be made at the unit price bid per cubic metre for "**Pit-Run Gravel - Supply and Place**". This payment will be full compensation for supplying, placing and compacting the pit-run, and all labour, equipment, tools and incidentals necessary to complete the Work.

53.2.6.3 Department Supply of Pit-Run

Payment will be made at the unit price bid per cubic metre for "**Pit-Run Gravel - Pick up and Place**". This payment will be full compensation for picking up, placing and compacting the pit-run material and all labour, equipment, tools and incidental necessary to complete the Work.

53.2.7 WARRANTY

When pit-run gravel is used as part of another maintenance activity such as pavement patching, the warranty period for the pit-run gravel will be the same as the warranty period specified for the applicable activity. Otherwise, there is no warranty required for this Work.



53.3 GRANULAR BASE COURSE

53.3.1 GENERAL

The Work consists of placing crushed granular base course material on a prepared area or in an excavation.

53.3.2 STANDARDS

Conform to the following Standards unless specified otherwise:

PNGS 1185 Methods for Sampling and Testing Aggregates.

AS 1289 Methods of Testing Soils for Engineering Purposes.

53.3.3 MATERIALS

The Contractor shall pick up crushed granular base course material from a source approved by the Engineer or supply crushed granular base course material in accordance with the following requirements.

53.3.3.1 Gravel

Obtain material from sources of naturally occurring deposits.

Produce required properties by crushing, screening, mixing and other processes necessary.

Ensure particles are tough, durable and of a tightly binding nature free of organic or other deleterious matter.

Conform to the tables GRAVEL PARTICLE SIZES and GRAVEL PROPERTIES.

53.3.3.1.1 TABLE - GRAVEL PARTICLE SIZES

AS SIEVE (mm)	PERCENTAGE PASSING	
	2	3
75.0		
37.5	100	
19.0	70 - 100	100
9.5	50 - 80	70 - 100
4.75	35 - 65	50 - 80
2.36	25 - 50	35 - 65
0.425	10 - 30	15 - 35
0.075	4 - 16	6 - 20

The Contract will specify the appropriate grading numbers for the work. Generally Gradings: 2 or 3 are for Basecourse. Grading 3 is for Shoulder.



53.3.3.1.2 TABLE - GRAVEL PROPERTIES

		SEALED BASE	UNSEALED BASE AND SHOULDER MATERIAL	SUB-BASE
1.	Liquid Limit (LL)	25% maximum (30%)	35% maximum	30% maximum
2.	Plasticity Index (PI)	1 - 6% (1 - 10%)	4 - 12%	1 - 10%
3.	Linear Shrinkage (LS)	0 - 3% (0 - 6%)	2 - 8%	0 - 6%
4.	PI x % passing 0.425 mm Sieve	180 maximum (300 maximum)	400 maximum	400 maximum
5.	California Bearing Ratio (CBR) 4 day soaked at 2.5 mm penetration at a relative density of	80 minimum 100% MMDD	50 minimum 95% MMDD	30 minimum 95% MMDD
6.	Los Angeles Abrasion (LAA) Loss	50 maximum	> maximum	60 maximum

53.3.3.2 Fine Crushed Rock

Manufacture from clean, hard durable rock free from clay, loam or other deleterious substances.

Conform to the tables CRUSHED ROCK SIZES and CRUSHED ROCK PROPERTIES.

53.3.3.2.1 TABLE - CRUSHED ROCK SIZES

AS SIEVE (mm)	PERCENTAGE PASSING
37.5	100
19.0	90 - 100
13.2	75 - 90
9.5	60 - 80
4.75	38 - 60
2.36	25 - 45
0.425	12 - 26
0.075	6 - 14



53.3.3.2.2 TABLE - CRUSHED ROCK PROPERTIES

1.	Liquid Limit (LL)	25% maximum
2.	Plasticity Index (PI)	1 - 6%
3.	Linear Shrinkage (LS)	3%
4.	Dust Ratio (DR) (% passing 0.075 mm)/(% passing 0.425 mm) x 100	25 - 50
5.	CBR, 4 day soaked at 100% MMDD at 2.5 mm penetration	100 minimum
6.	Los Angeles Abrasion (LAA) Loss: coarse grained rock fine grained rock	35 maximum 25% maximum
7.	PI x % passing 0.425 mm sieve	180 maximum

53.3.3.3 Sand Clay

A material complying with the following:

53.3.3.3.1 GRADING

AS SIEVE (mm)	PERCENTAGE PASSING
4.75	80 - 100
2.36	60 - 100
0.425	30 - 60
0.075	14 - 28

53.3.3.3.2 PROPERTIES

Plasticity Index: 20 maximum for sealed pavements
15 maximum for unsealed pavements.

Linear Shrinkage: 1% - 8%.

CBR, 4 day soaked at 95% MMDD
at 2.5 mm penetration: 50 minimum.

53.3.3.4 Supply to Stockpile

Clear the site.

Ensure the area is free draining.

Spread and compact a 75 mm thick layer of sub-base gravel to 95% relative compaction.

Trim stockpile to a uniform shape for ease of measurement.

53.3.4 PROCEDURE

Granular base course material shall be placed on the prepared area or in an excavation so as to produce a well compacted and uniform surface to an elevation specified by the contract drawings, below the existing pavement surface or on a gravel roadway, to the final roadway surface elevation.

The Contractor shall complete the Work immediately after excavating an area or placing and compacting other fill materials. The Contractor shall diligently complete all aspects of the Work.



Deposit and spread the material in uniform level layers to a minimum compacted thickness of 100 mm and maximum compacted thickness of 200 mm loose measurement for the full width of fill.

Achieve a homogeneous mass with no compaction planes.

Compact each layer to the specified compaction (refer Table - Dry Density Ratios for Conformance) before placing the next layer.

Use standard fill for the subgrade.

53.3.5 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer

53.3.5.1 Tolerances

Finish Basecourse to a smooth compacted and uniform surface within the dimensions and levels as shown in the drawings. Placed Basecourse and Subgrade shall conform to the following requirements:

Table - Dry Density Ratios for Conformance

Works Components	A Mean Dry Density Ratio (R) % ("n" is 3 to 5)	B Characteristic Mean Dry Density Ratio (Rc) % ("n" is 6 or greater)	
Natural surface to subgrade, fill, batters, table drain blocks, fill for water course, unpaved areas	90.0 or greater 89.9 or less	90.0 or greater 89.9 or less	Conformance Non-conformance
Subgrade, sub-base, unsealed base, shoulders, select fill, levees, structures and culverts in fill, bridge foundation backfill, bridge abutment fill	95.0 or greater 94.9 or less	95.0 or greater 94.9 or less	Conformance Non-conformance
Sealed basecourse	100.0 or greater 99.9 or less	99.0 or greater 98.9 or less	Conformance Non-conformance
Stabilised basecourse	98.0 or greater 97.9 or less	97.0 or greater 96.9 or less	Conformance Non-conformance
Backfill all test excavations with the material and density ratio specified for that layer stabilised with at least 3% cement (by mass).			

53.3.5.2 Proof Rolling

The Contractor shall:

- proof roll all areas and obtain satisfactory results before ordering conformance testing of those areas.
- submit a proof rolling procedure to the Engineer for approval including the method of preparing an area and the extent of proof rolling.
- give the Engineer not less than 24 hours notice of the location and commencement time for the proof rolling
- use plant in proof rolling procedures that comply with the following requirements:
 - static smooth wheeled rollers with a mass of not less than 12 tonnes and a load intensity under either the front or rear wheels of not less than 6 tonnes per metre width of wheel;



- pneumatic tyred plant with a mass of not less than 20 tonnes and with a ground contact pressure under either the front or rear wheels of not less than 450 kPa per tyre and a ground contact area of not less than 0.035 sq.m. per tyre;
- check areas for level tolerance and layer thickness before proof rolling;
- Proof roll each layer immediately following completion of compaction. If proof rolling is carried out at a later time, water the surface and roll with the test roller prior to commencement of proof rolling.
- the proof rolling requirements are deemed to comply when an area withstands proof rolling without visible deformation or springing.
- remove and reconstruct areas that deform or break up.

Subgrade surface will be tested only when it is within level tolerance and conforms to proof rolling.

Check subgrade surface levels prior to testing.

obtain the Superintendent's approval of subgrade conformance prior to placing further material.

53.3.6 MEASUREMENT AND PAYMENT

53.3.6.1 General

Measurement will be in cubic metres based on truck box measurement.

Payment for hauling, if required, will be made in accordance with **Specification 56.2, Hauling**.

53.3.6.2 Contractor Supply of Granular Base Course

Payment will be made at the unit price bid per cubic metre for "**Granular Base Course - Supply and Place**". This payment will be full compensation for supplying, placing and compacting the granular base course, and all labour, equipment, tools and incidentals necessary to complete the Work.

53.3.6.3 Department Supply of Granular Base Course

Payment will be made at the unit price bid per cubic metre for "**Granular Base Course - Pick up and Place**". This payment will be full compensation for picking up, placing and compacting the granular base course material and all labour, equipment, tools and incidental necessary to complete the Work.

53.3.7 WARRANTY

When granular base course is used as part of another maintenance activity such as asphalt pavement deep patching, the warranty period for the granular base course will be the same as the warranty period specified for the applicable activity. Otherwise, there is no warranty required for this Work.



53.4 FORMATION CLEARING, GRUBBING AND STRIPPING

53.4.1 GENERAL

The Work consists of clearing and grubbing of vegetation, stumps, roots, soil, rocks, debris, structures and any other object identified by the Engineer generally for the rehabilitation or strengthening of existing gravel surface roadways or approaches. When required by the Contract, the stripping, transportation and disposal of top soil to a depth of 150mm, shall be included in the scope of works. The cleared materials shall be mulched, stockpiled and reused or disposed of, as directed by the Engineer.

This specification does not apply for excavation and backfill associated with the installation or removal of culverts or pavement patching.

53.4.2 STANDARDS

Conform to the following Legislation, Standard and Publication unless specified otherwise:

- i. Papua New Guinea Environment Act, 2000;
- ii. Department of Works Environment Guidelines.

53.4.3 EQUIPMENT

The Contractor shall supply all equipment necessary to complete the Work.

53.4.4 PROCEDURE

53.4.4.1 General

The Contractor shall clearly indicate in writing, the location and manner of waste disposal sites to be used, and obtain approval from the Local Level Government, the Provincial Government and the Engineer in that order, prior to commencing the work.

Clear the formation of the road a minimum width of 2 metres on each side past the outside batters of the table drains over the full length of the Site and at other locations, hereunder called “the area” as directed by the Engineer.

Recut the outer batters or table drains, ensuring the prevention of any excess materials from washing back into the table drains, offlet drains culverts or other drainage structures.

The Contractor shall not be responsible for payment of compensation to landowners for any land, property, or crops damaged within the limits of clearing for the Works. However, the Contractor shall be responsible for payment of compensation to landowners for any damage to land, property or crops caused by the Contractor to areas outside the limits for clearing for the Works.

Unless otherwise indicated by the Contract, cleared material shall be transported and disposed of, off-site at a location approved by the Engineer.

53.4.4.2 Mulching

53.4.4.2.1 General

Where required by the contract, mulch cleared vegetative matter in mechanical brush chippers to a maximum size of 100mm as the clearing work proceeds. Do not stockpile cleared material for later mulching.



53.4.4.2.2 Stumps

Stumps and other material unsuitable for mulching may be buried in disused gravel pits during rehabilitation of the pits.

53.4.4.2.3 Grasses

Do not mulch grass clods, roots or other components containing viable propagules. This material may be buried in disused gravel pits.

53.4.4.2.4 Stockpiles

Stockpile mulched material on the site at a maximum height of 2m for use during reinstatement work.

In urban areas, stockpile mulch on the site for reuse and deliver surplus mulch as directed by the Engineer (within 10 kms of the site) for use in local landscaping projects.

In rural areas, stockpile mulch on the site for reuse and power blow surplus mulch into the adjacent natural vegetated areas adjacent to the works.

53.4.5 ACCEPTANCE CRITERIA

Acceptance shall be subject to the visual inspection and satisfaction of the Engineer that all required clearing, grubbing and stripping work, not less than the specified formation width, depth and project length, have been completed as required; waste material have been transported away from the Site and disposed of in an approved manner; and all damage to property, crops and land outside the area, is identified, documented and reported to the Engineer and property owner, by the Contractor.

53.4.6 MEASUREMENT AND PAYMENT

53.4.6.1 Excavation

Measurement for "**Formation clearing, grubbing and stripping**" will be in square metres.

Payment will be made at the unit price bid per square metre for "**Formation clearing, grubbing and stripping**". This payment will be full compensation for clearing vegetation, structures, debris and all other designated material and objects; the grubbing of roots, stumps and embedded logs, rocks, and other objects; the stripping of topsoil to a depth of 150mm; the disposing of the waste material; and all labour, equipment, tools and incidental necessary to complete the Work.

Measurement and payment for the haul of excavated material designated for disposal, shall be included in the unit bid rate.

53.4.7 WARRANTY

There is no warranty period for this Work.



53.21 SEALED PAVEMENT CRACK MAINTENANCE

53.21.1 GENERAL

This section specifies the repairs to isolated cracks on existing bituminous surfaces and pavements with asphalt.

53.21.2 STANDARDS

Conform to the following Standards and Publications unless specified otherwise:

PNGS 1185	Methods for Sampling and Testing Aggregate.
AS 1160	Bitumen Emulsion for Construction and Maintenance of Pavements.
AS 1348.1	Road and Traffic Engineering: Part 1 Road Design and Construction.
PNGS 1373	1990 Residual Bitumen for Pavements.
AS 2357	Mineral Fillers for Asphalt.
AS 1289.3.3.1	Methods for testing soils for engineering purposes – Calculation of the plasticity index of a soil.
AS 1289.3.7.1	Methods for testing soil for engineering purposes – Determination of the sand equivalent
AS 2891	Methods of Sampling and Testing Asphalt.
AUSTROADS	A Guide to the Visual Assessment of Pavement Conditions
AUSTROADS	AP-G66/02: Asphalt Guide
NAASRA	Bituminous Surfacing Volume 2 Asphalt Work 1984.
ASTM	ASTM D562, EC-101; ASTM D244, EC-10; ASTM D36, ASTM D5, ASTM D2170

53.21.3 MATERIALS

53.21.3.1 Commercially Produced Sealants/Fillers

The use of commercially produced Pavement Crack Sealants or fillers is the preferred repair material.

The Contractor shall supply the type, grade and manufacturer's specifications or Technical Data and Material Safety Data Sheet (MSDS) of the asphalt/emulsified asphalt material which must comply with relevant Australian and or ASTM Standards.

The use of "other" materials will be subject to the approval of the Engineer. In situations where the Contractor intends to obtain approval to use "other" materials, he shall provide the Engineer with the following information 5 days prior to commencing the Work:

- Name and mailing address of crack sealant supplier and manufacturer;
- Name of crack sealant product to be supplied;
- Name of Standards to which the product complies with;
- Manufacturers Technical Data or Specifications and MSDS for the product;
- Written confirmation from the manufacturer that the crack sealant to be supplied meets all specified requirements along with independent test results and certifications that demonstrate that the product meets all specified requirements.



The Contractor shall verify that all crack sealant delivered and used in the Work is the type and grade ordered.

The Contractor shall supply the Engineer with the manufacturer's quality control test results, as identified in Table 53.21.3.1.1, for each batch of crack sealant. These test results shall be supplied at the time of delivery of each batch of crack sealant to the Work.

53.21.3.1.1 TABLE: QUALITY CONTROL TESTING REQUIREMENTS

PRODUCT	QUALITY CONTROL TESTING	REQUIREMENTS
COLD POUR	a) Uniformity b) Viscosity c) Solids Content d) Rate of Curing (24 hour)	EC-101 ASTM D562 ASTM D244 EC-101
HOT POUR	a) Softening Point b) Penetration @ 25EC c) Viscosity	ASTM D36 ASTM D5 ASTM D2170

53.21.3.2 Bituminous Slurry

In the absence of commercially produced Bituminous Pavement Crack Sealants/Fillers, and for large Cracks, greater than 25mm wide, the Contractor shall prepare Bituminous Slurry for Crack patching, in consultation with the Engineer.

53.21.3.2.1 BINDER – APPROVAL

Use bitumen emulsion binder complying with AS 1160.

Approval - Additives to improve the workability of the mix, or to accelerate or retard setting of the mix may be used with the approval of the Engineer.

53.21.3.2.2 AGGREGATES

Use mineral aggregate consisting of crushed stone, clean, sharp, angular sand and mineral filler combined to meet the grading as specified in the MIX REQUIREMENTS clause and as set out in the STANDARD MIXES TABLE.

Use clean aggregate free from vegetable matter, oversize stone and other deleterious substances.

Use combined aggregate and mineral filler having a sand equivalent value of not less than 45 when tested in accordance with AS 1289.3.7.1. and a plasticity index less than 5 when tested in accordance with AS 1289.3.3.1.

53.21.3.2.3 WATER

Use only potable water with less than 600 ppm suspended solids.

53.21.3.2.4 MINERAL FILLER

Use an approved mineral product having a minimum of 85% passing a 0.075mm sieve, thoroughly dry and free from lumps, organic matter and clay particles.

53.21.3.2.5 STOCKPILES

Provide a separate site for each aggregate size and allow 15 metres between adjacent sites.

Ensure sites are well drained and on hard ground. Avoid contamination by dust.

Maintain access roads and stockpile sites.



Avoid sites under trees, telephone lines, overhead transmission lines or where overhead clearance is less than 6 metres.

Clear vegetation and rubble to 5 m beyond stockpile boundary and ensure that the site is self draining.

Construct gravel foundation for stockpiles with 100 mm compacted thickness. Trim and compact to 95% relative compaction.

Construct stockpiles at least 1 metre high and batter sides 1 vertical to 1.5 horizontal and trim neatly to facilitate measurement.

Remove from site any non-conforming aggregate.

53.21.3.3 Mix Requirements

53.21.3.3.1 GENERAL

Blend the bitumen emulsion with the mineral aggregate and filler in the proportions, by dry mass of aggregate, including filler, to give the required bitumen content of the slurry surfacing mix as specified in the STANDARD MIXES TABLE.

Add sufficient water to provide a mix of workable consistency and this may be varied slightly to suit the surface texture of the pavement and the pavement temperature.

53.21.3.3.2 STANDARD MIXES - TABLE

SIEVE SIZE MM	PERCENTAGE OF MINERAL AGGREGATE PASSING SIEVE BY MASS	
	NOMINAL MIX SIZE	
	7 MM	5 MM
13.2	100	100
9.5	100	100
6.7	85-100	100
4.75	70-90	90-100
2.36	45-70	50-70
1.18	28-50	35-50
0.60	19-34	20-35
0.30	12-25	12-25
0.15	7-18	7-18
0.075	5-15	4-10
Residual binder content as % mass of aggregate	6.5 - 9	7 - 9.5

53.21.3.3.3 SAMPLE MIXES – APPROVAL

Make trial batches to determine the final blend of water, additive and cement to be used for the best results.

Approval - At least 14 days before commencing work, forward the details of the mix design, carried out in a National Institute of Standards and Industrial Technology (NISIT) registered laboratory and performed by a NISIT accredited technician, to the Engineer for endorsement. Once the mix design is endorsed by the Engineer it becomes the specified job mix.



53.21.3.3.4 DEPARTURES FROM THE JOB MIX – TABLE

The following table provides the maximum mean departures from the job mix for any day’s work:

	SIEVE SIZE IN MM	% BY MASS
Aggregate	6.7	7
	4.75	7
	2.36	5
	1.18	5
	0.60	4
	0.30	4
	0.15	3
	0.075	2
Bitumen Content		+ 1.0 - 0.5

If the mix gradings and binder content depart from the job mix by more than any of the maxima shown in the table, halt production until the mix is corrected.

53.21.4 PLANT & EQUIPMENT

53.21.4.1 Mixer

The mixture may be mixed by hand or with the use of a motorised mixer, depending on the required production rates, with the approval of the Engineer.

The mix shall be accurately proportioned and the mix method shall be capable to meet the required delivery rate to sufficiently complete the work.

53.21.4.2 Applicator

The mix shall be applied with a handheld container fitted with an appropriate delivery nozzle to ensure accurate application to the crack. The application equipment will be approved by the Engineer prior to use.

53.21.4.3 Ancillary Plant

Contractor shall provide all ancillary plant such as rotary road brooms, signs, lamps, barricades, hand squeegees, shovels, hand brooms and any other equipment necessary for the performance of the work.

53.21.5 PROCEDURES

The work area shall be a maximum of 3 kilometres in length.

No Work shall be performed during rain or when the pavement surface or cracks are wet.

The crack sealant shall not be applied when the pavement temperature is below 0° Celsius.

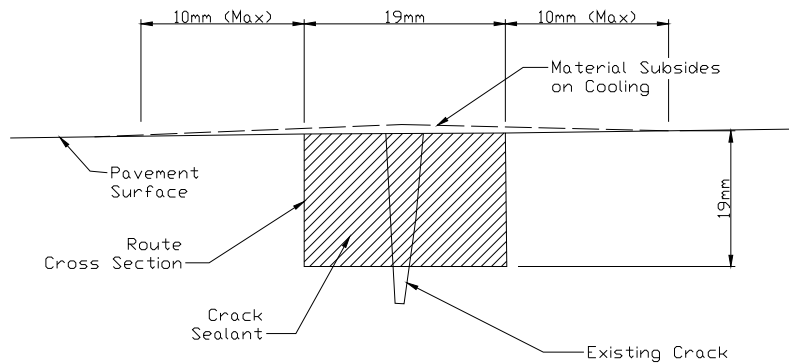
All cracks within the entire width of the pavement surface, which are between 5 mm and 25 mm in width, shall be sealed.

When specified by the Engineer, all transverse cracks between 2 mm and 25 mm in width and longitudinal cracks between 2 mm and 12 mm in width shall be routed prior to sealing with sealant/filler. The Contractor shall measure and record the length of every crack treated and inform the Engineer of the total when nearing the estimated amount shown on the Contract.

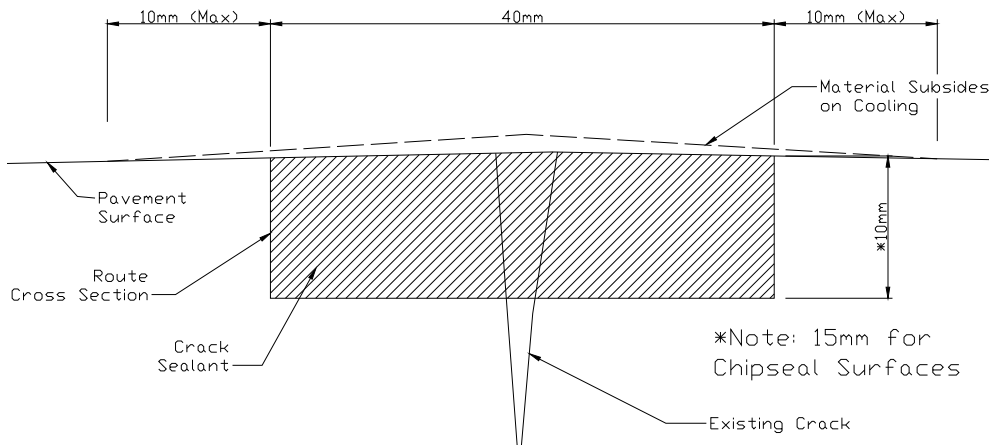
Cracks shall be routed to the applicable cross-section shown on the drawing below, keeping the crack in the centre of the route cross-section.



53.21.5.1 FIGURE – CRACK ROUTING AND SEALING



Longitudinal Crack Routing and Sealing



Transverse Crack Routing and Sealing

Prior to application of the sealant/filler, first clean the crack with air pressure or other approved method. The Contractor shall ensure that the road surface adjacent to the crack is clean.

Fill crack with a binder having viscosity low enough to enable it to be poured or worked into the crack.

Hot Pour crack sealant shall be heated to the temperature specified by the manufacturer. Overheating will not be permitted.

Crack sealant shall be applied within the manufacturer's specified temperature range. Crack sealant shall be applied so that the crack is flush filled immediately following application and a thin overband of sealant extends approximately 25 mm beyond the edges of the crack. Excess crack sealant shall be removed from the pavement surface immediately following application. Removal shall involve the use of a squeegee, starting from the centerline and proceeding to the shoulder.



Take care to ensure that the cutback bitumen, bitumen emulsion, rubberised bitumen or latex modified bitumen used does not bridge across the crack at the surface. Assist the binder to penetrate crack by using a squeegee.

Traffic shall be kept off sealed cracks until the crack sealant will not track under the action of traffic. At locations such as intersections where this is not practical, the Contractor shall prevent tracking by applying a blotting agent to the crack sealant.

When necessary, the Contractor shall supply one of the following blotting agents:

- screened sand with a maximum top-size of 2 mm
- cement
- flyash

The use of other blotting products shall be subject to the approval of the Engineer.

Fuel, asphalt and any other spills shall be cleaned up to the satisfaction of the Engineer at the Contractor's expense.

For very wide cracks, first clean the crack thoroughly of dirt, loose matter, water and any other foreign material and then fill with fine asphalt or bituminous slurry.

Large areas with fine cracks and minimal pavement distortion will be spray sealed, slurry sealed or resurfaced with plant mix, in accordance with other sections of the specification.

53.21.6 SAMPLING AND TESTING

The Contractor shall retain copies of his supplier's QC testing results, and undertake the quality control testing and inspections as required by its QC Programme. The Contractor shall make available, all QC test and inspections results when requested by the Engineer. The Contractor shall supply material samples to the Engineer for QA (Audit) testing purposes when requested.

The Contractor shall provide the Engineer with one representative sample of crack sealant material at the start of the job, each time the sealant material is changed, or for every 10,000 litres of an unchanged sealant used.

53.21.7 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer. To be acceptable, the Work must conform to the following:

- all routed cracks conform with the specified route profile;
- the route conforms to the path of the crack with no part of the crack outside or touching the edge of the route cross-section;
- all routed cracks have been sealed; and
- at least 95% of the cracks treated have been filled with an adequate amount of crack sealant/filler material;

Failure to comply with the acceptance criteria will result in the Contractor re-treating all failed cracks at his own expense.

53.21.8 MEASUREMENT AND PAYMENT

53.21.8.1 Crack Sealing

Measurement will be in metres of the length of crack sealed.



Payment will be made at the unit price bid per metre for "**Crack Sealing**". This payment will be full compensation for cleaning the road surface adjacent to the cracks, supplying and applying the crack sealant, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

53.21.8.2 Crack Routing and Sealing

Measurement will be in metres of the length of crack routed and sealed.

Payment will be made at the unit price bid per metre for "**Crack Routing and Sealing**". This payment will be full compensation for routing, cleaning and drying the cracks, cleaning the pavement surface, supplying and applying the crack sealant, measuring and recording the length of cracks treated and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

53.21.8.3 Crack Sealing - Blotting

When the Engineer directs the Contractor to apply one of the aforementioned blotting agents, a supplementary payment will be made at the unit price bid per length of crack treated for "**Crack Sealing - Blotting**." This payment will be full compensation for supplying and applying the blotting agent, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

53.21.9 WARRANTY

53.21.9.1 Crack Sealing

The warranty period for this Work shall be 30 days.

53.21.9.2 Crack Routing and Sealing

The warranty period for this Work shall be 1 year. At the end of the warranty period at least 90% of all treated cracks must continue to be sealed.



53.22 SEALED PAVEMENT POTHOLE PATCHING

53.22.1 GENERAL

The Work consists of repairing potholes and delaminations in sealed pavements by cleaning the hole of loose material, filling the hole with a bitumen mixture or proprietary patching material and compacting the mix to provide a smooth, hard surface and a smooth transition to the surrounding pavement.

53.22.2 STANDARDS

Conform to the following Standards and Publications unless specified otherwise:

PNGS 1185	Methods for Sampling and Testing Aggregate.
AS 1160	Bitumen Emulsion for Construction and Maintenance of Pavements.
AS 1348.1	Road and Traffic Engineering: Part 1 Road Design and Construction.
PNGS 1373	1990 Residual Bitumen for Pavements.
AS 2150	Hot mix Asphalt.
PNGS 1374	Cut Back Bitumen.
AS 2357	Mineral Fillers for Asphalt.
AS 2758.5	Aggregates and Rock for Engineering Purposes: Asphalt Aggregates.
AS 2891	Methods of Sampling and Testing Asphalt.
AS 4283	Cold Mix Asphalt for Maintenance Patching
AUSTROADS	A Guide to the Visual Assessment of Pavement Conditions
AUSTROADS	AP-G66/02: Asphalt Guide
NAASRA	Bituminous Surfacing Volume 2 Asphalt Work 1984.

53.22.3 MATERIALS

The Contractor shall supply pothole patch material, or commercially produced proprietary patching material, satisfactory to the Engineer. Preparation and application of approved proprietary patching materials shall closely follow manufacturer's instructions.

53.22.3.1 Aggregates

The combined particle size distribution to be in accordance with the tables MIX PROPORTIONS.

53.22.3.1.1 COARSE AGGREGATES

Ensure that coarse aggregates are clean, hard, high strength, angular, skid resistant, durable crushed stone of uniform quality and free from laminated particles, clay and other aggregations of fine material, soil, organic matter and any other deleterious material. Conform to the following:

Proportion of misshapen particles: 15% maximum at 2:1 caliper ratio.

Los Angeles Abrasion

– Fine grained aggregate: 30% maximum loss.

– Coarse grained aggregate: 35% maximum loss.

Sulphate Soundness: 12% maximum loss.

Polished Aggregate Friction Value: 45 minimum.



53.22.3.1.2 FINE AGGREGATES

Ensure that fine aggregates are clean, hard, sharp, washed, durable natural sand and/or material manufactured from crushed stone of uniform quality and free from clay and other aggregations of fine material, soil, organic matter and any other deleterious material.

53.22.3.2 Mineral Filler

A finely divided mineral material, hydrated lime or cement with a particle size smaller than 0.075 mm.

Use filler that is dry, free from lumps, clay, organic material or any other deleterious material, and complies in all other respects with the requirements of AS 2357.

53.22.3.3 Bituminous Binder

A straight run bitumen Class 170 or Class 320, as specified by the contract

53.22.3.4 Bitumen Emulsion

A rapid setting bitumen emulsion made with bitumen Class 320

53.22.3.5 Additive

An additive may be proposed provided that full details of the type of additive are provided and the mix design standards of the PROPORTIONING OF MIXES Clause are attained.

53.22.3.6 Proportioning Of Mixes For Hot Mix Asphalt

53.22.3.6.1 MIX TYPE FOR HOT MIX ASPHALT

The Contract will specify Rural and/or Urban Mix Type Number to be applied.

53.22.3.6.2 MANUFACTURE OF HOT MIX ASPHALT

Mix in a plant capable of producing asphalt that complies with the approved design mix.

Bitumen temperature: 135 deg. C to 160 deg. C prior to mixing.

Heat aggregates to such a temperature that when filler and binder are added, the temperature of the mixed asphalt is between 135 deg. C and 170 deg. C.

53.22.3.6.3 MIX ASSESSMENT AND APPROVAL OF HOT MIX ASPHALT TYPES

Upon request by the Engineer, provide a minimum of 3 Marshall Test results of a job mix and submit to the Engineer the following:

- A statement detailing the combined aggregate/filler grading and binder content of the design mix, and the proportion of each constituent material in the design mix.
- Samples of the constituent materials in the design mix, and
- Details of the type of additive/s if any, and its proportion within the mix.

Upon request by the Engineer, provide sample quantities as listed in the Table - CONSTITUENT MATERIAL SAMPLE QUANTITIES FOR HOT MIX ASPHALT.



53.22.3.6.4 CONSTITUENT MATERIAL SAMPLE QUANTITIES FOR HOT MIX ASPHALT

Material	Sample Quantity
Binder	15 litres
Coarse Aggregate	
- Each constituent material nominal size $\geq 10\text{mm}$	100 kg
- Each constituent material nominal size $< 10\text{mm}$	75 kg
Fine Aggregate - each constituent material	50 kg
Added Filler	5 kg
Additive	As requested - sufficient for job mix verification

At the discretion of the Engineer, the submitted samples will be dispatched to an appropriate asphalt testing laboratory for Level 1 and Level 3 testing, as per the procedures of AP-G66/02 (Asphalt Guide).

Using the samples of constituent materials submitted, the proposed design mix may be assessed for compliance with the requirements of Clause: PROPERTIES and TABLE – MIX PROPORTIONS. The proposed job mix shall have a maximum Wheel Tracking Rate of 0.35mm per 1,000 passes at design air voids for urban work, and 0.45mm per 1,000 passes at design air voids for rural work, as determined by the Wheel Tracking test defined in AP-G66/02 (Asphalt Guide). The Wheel Tracking Rate is the slope of the rut depth versus number of passes curve between 4,000 and 10,000 passes. Adjust the proposed mix design as required to satisfy the specified requirements.

The Combined aggregate/filler grading of the approved job mix will be termed the Approved Job Grading. The binder content of the approved job mix will be termed the Approved Job Binder Content.

Failure of submitted samples of constituent materials or the job mix to comply with the requirements specified herein will result in rejection of the job mix. In this case, submit a revised job mix design.

53.22.3.6.5 PROPERTIES OF HOT MIX ASPHALT

Conform to the following mix requirements:

MARSHALL CHARACTERISTICS	RURAL	URBAN
Compactive effort (number of blows each end of specimen):	50	75
Stability of mix (kN):	5 minimum	8 minimum
Flow (mm):	2 – 5	2 – 5
Air voids (%):	3 – 7	3 – 7
Voids in mineral aggregate (%):	14 minimum	14 minimum

Conform to the following target mix proportions and properties;



53.22.3.6.6 TABLE - MIX PROPORTIONS

Mix Type	HM 1	HM 2	HM 3	HM 4	HM 5	HM 6
	DENSE GRADED			OPEN GRADED		
	% PASSING (DRY MASS)					
AS SIEVE (mm)	5 mm	10 mm	14 mm	20 mm	10 mm	20 mm
53.0						
37.5						
26.5				100		100
19.0			100	95 – 100		95 - 100
13.2		100	85 – 100	75 – 90	100	80 - 90
9.5		90 - 100	70 – 85	60 – 80	90 - 100	65 - 80
6.7	100	70 - 90	62 – 75	50 – 70	40 - 70	52 - 65
4.75	85 - 100	58 - 76	53 – 70	40 – 60	30 - 50	45 - 55
2.36	55 - 75	40 - 58	35 – 52	25 – 43	10 - 30	30 - 43
1.18	38 - 57	27 - 44	24 – 40	18 – 35	5 - 20	20 - 35
0.60	26 - 43	17 - 35	15 – 30	14 – 27	0 - 15	14 - 27
0.30	15 - 28	11 - 24	10 – 24	9 – 21	0 - 10	9 - 21
0.15	8 - 18	7 - 16	7 – 16	6 – 15	0 - 7	7 - 15
0.075	4 - 11	4 - 7	4 – 7	3 – 7	0 - 4	3 - 6
Bitumen binder (% by mass)	5.0 - 7.0	4.5 - 6.5	4.6 - 6.5	4.0 – 6.0	3.5 – 5.5	3.5 - 5.5
Compacted thickness (mm)	10 - 25	25 - 40	35 – 55	50 – 80	25 - 40	50 - 80
Bitumen film thickness (min micron)	8.5	8.5	8.5	8.5	8.5	8.5

The grading curve shall be smooth and shall not vary from the outer one third of the range between the specified limits for one sieve size to the opposite outer one third of the range between the specified limits for an adjacent sieve size.

53.22.3.7 Proportioning Of Mixes For Cold Mix Asphalt

53.22.3.7.1 MIX TYPE FOR COLD MIX ASPHALT

The Contract will specify the Mix Type Number to be applied.

53.22.3.7.2 MANUFACTURE OF COLD MIX ASPHALT

Dry mix aggregate and mineral filler to provide a homogenous blend.

Add bituminous binder until the specified percentage is reached.

Carry out further mixing until a minimum of 90% of the coarse aggregate particles are coated.

Add additional bitumen so that a satisfactory mix can be achieved, if so directed by the Superintendent.

Conform to the following mix proportions;



53.22.3.7.3 TABLE – AGGREGATE AND MINERAL FILLER MIX PROPORTIONS

Mix Type	CM 1	CM 2	CM 3	CM 4	CM 5	CM 6	CM 7	CM 8
	DENSE GRADED				OPEN GRADED			
	% PASSING (DRY MASS)							
AS SIEVE (mm)	7 mm	10 mm	14 mm	20 mm	7 mm	10 mm	14 mm	20 mm
53.0								
37.5								
26.5				100				100
19.0			100	95 – 100			100	95 – 100
13.2		100	85 – 100			100	90 – 100	50 – 90
9.5	100	90 – 100	70 – 85	58 – 74	100	90 – 100	40 – 75	30 – 65
6.7	90 – 100			45 – 60	85 – 100	30 – 75	10 – 35	10 – 35
4.75	70 – 90	58 – 70	46 – 65	37 – 50	30 – 70	20 – 55	5 – 25	5 – 25
2.36	45 – 60	35 – 50	28 – 45	22 – 36	10 – 40	5 – 30	0 – 10	0 – 10
1.18		22 – 38	15 – 30	12 – 26	0 – 20	0 – 10		
0.60	15 – 30	12 – 27	10 – 23	6 – 20	0 – 10			
0.30	10 – 20	6 – 16	5 – 17	4 – 15				
0.15	4 – 14	4 – 14	3 – 11	2 – 10				
0.075	3 – 8	2 – 6	2 – 5	1 – 5	0 – 4	0 – 4	0 – 4	0 – 4
Total %	100	100	100	100	100	100	100	100

The grading curve shall be smooth and shall not vary from the outer one third of the range between the specified limits for one sieve size to the opposite outer one third of the range between the specified limits for an adjacent sieve size.

53.22.3.7.4 TABLE – TOTAL MIX PROPORTIONS OF COLD MIX ASPHALT

Mix Type	CM 1	CM 2	CM 3	CM 4	CM 5	CM 6	CM 7	CM 8
	DENSE GRADED				OPEN GRADED			
SIZE	7 mm	10 mm	14 mm	20 mm	7 mm	10 mm	14 mm	20 mm
Material	% OF TOTAL MIX							
Aggregate and filler %	94.2 – 95.2	94.8 – 95.8	95.0 – 96.0	95.3 – 96.3	95.0 – 96.0	95.5 – 96.5	95.5 – 96.5	96.0 – 97.0
Residual binder %	4.8 - 5.8	4.2 - 5.2	4.0 - 5.0	3.7 - 4.7	4.0 - 5.0	3.5 - 4.5	3.5 - 4.5	3.0 - 4.0
Total Mix %	100	100	100	100	100	100	100	100



53.22.3.7.5 SPECIFICATION LIMITS FOR THE BINDER MIX OF COLD MIX ASPHALT

- Bitumen: 100 parts
Flux: Between 5 and 15 parts, depending on location and climatic conditions.
Cutter: 10 parts

53.22.4 PROCEDURES

Prior to the commencement of any pavement works, the Contractor is to confirm and agree with the Engineer, the Pothole size Categories and or the extent of repairs. The Pothole Categories are as follows:

CATEGORY	SURFACE AREA (M ²)
A	Not greater than 0.25
B	0.25 or greater, but less than 1.0
C	1.0 or greater, but less than 2.5
D	2.5 or greater, but less than 4.0
D+	4.0 or greater

Prepare the hole by removing all loose aggregate, dust and the like. Trim to straighten edges with square corners and remove materials to sound material base, creating vertical sides, square with bottom.

The Contract will specify the suitable type and size of hot mix asphalt or cold mix asphalt for patch material.

Tack coat the sides and bottom with bitumen emulsion or cut back bitumen. Remove excess tack coat.

Place patching material in layers no greater than 2.5 times the nominal size, and thoroughly compact.

Finish the pothole slightly higher than adjacent pavement surface, between 3mm and 5mm.

When using cold mix, thoroughly aerate the mix to remove some cutter oil or flux oil.

Level the patch by hand raking, motor grader or pull type blade.

Remove all loose aggregate around the edges of the patch so patch can be raked and rolled to a smooth junction with the old surface.

Compact asphalt material with hand tamper for small holes and where possible, compact by using a rammer or vibrating plate.

Compact large patches with a vibrating smooth drum roller.

Cold mix patches should be topped with a light application of sand to prevent pick up.

Temporary patching with aggregate and emulsion requires the approval of the Engineer. For such work, keep traffic off the patch until patch is stable.

53.22.5 SAMPLING AND TESTING

The Contractor shall retain copies of his supplier's QC testing results, and undertake the quality control testing and inspections as required by the Contractor's QC Program. The Contractor shall make available, all QC test and inspection results when requested by the Engineer. The Contractor shall supply material samples to the Engineer for QA (Audit) testing purposes when requested.



53.22.6 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer. To be acceptable, patches must provide a dense, smooth and level transition between the treated area and the adjacent undisturbed pavement surface. Any loose material must be removed and the site left in a clean condition.

The Contractor shall re-treat any failed areas at his expense.

53.22.7 MEASUREMENT AND PAYMENT

Pothole repair work shall be measured in accordance with the categories in Sub-Clause 53.10.3. The unit of measurement for pothole categories A, B, C, and D shall be by the number of potholes repaired. The unit of measurement for potholes in category D+ shall be the plan area, in square metres, to the extent as agreed under Sub-Clause 53.22.4. The Contractor shall not be paid for any works conducted in excess of the agreed extent.

Payment shall be made at the unit price bid for “Sealed Pavement Pothole Patching – Category A; or Sealed Pavement Pothole Patching – B; or Sealed Pavement Pothole Patching – C; or Sealed Pavement Pothole Patching – D”. This payment will be full compensation for all work necessary to prepare the pothole, supply, place and compact patch material to potholes, to existing road levels and all labour, equipment, tools and incidental necessary to complete the Work.

The Contractor shall be responsible for all costs associated with the supply, delivery and construction of patch materials including any royalty payments for materials extracted from approved quarries.

53.22.8 WARRANTY

The warranty period for this Work shall be 90 days.



53.23 SEALED PAVEMENT - SLURRY SURFACING

53.23.1 GENERAL

The work consists of slurry surfacing of existing sealed surfaces to seal small cracks and surface voids and to repair oxidation, and prevent ravelling or aggregate loss.

53.23.2 STANDARDS

Conform to the following Standards and publications unless specified otherwise.

AS 1160	Bituminous emulsions for the construction and maintenance of pavements.
AS 1289.3.3.1	Methods for testing soils for engineering purposes – Calculation of the plasticity index of a soil.
AS 1289.3.7.1	Methods for testing soil for engineering purposes – Determination of the sand equivalent of a soil using a power operated shaker.
AS 2357	Mineral Fillers for Asphalt.
AUSTROADS: SST-04	Wet track abrasion test
ISSA TB 114	Wet stripping test.

53.233 MATERIALS

53.23.3.1 Binder

Use bitumen emulsion binder complying with AS 1160.

Additives to improve the workability of the mix, or to accelerate or retard setting of the mix may be used with the approval of the Engineer.

53.23.3.2 Aggregates

Use mineral aggregate consisting of crushed stone, clean, sharp, angular sand and mineral filler combined to meet the grading as specified in the MIX REQUIREMENTS clause and as set out in the STANDARD MIXES TABLE.

Use clean aggregate free from vegetable matter, oversize stone and other deleterious substances.

Use combined aggregate and mineral filler having a sand equivalent value of not less than 45 when tested in accordance with AS 1289.3.7.1. and a plasticity index less than 5 when tested in accordance with AS 1289.3.3.1.

53.23.3.3 Water

Use only potable water with less than 600 ppm suspended solids.

53.23.3.4 Mineral Filler

Use an approved mineral product having a minimum of 85% passing a 0.075mm sieve, thoroughly dry and free from lumps, organic matter and clay particles.

53.23.3.5 Stockpiles

Provide a separate site for each aggregate size and allow 15 metres between adjacent sites.

Ensure sites are well drained and on hard ground. Avoid contamination by dust.

Maintain access roads and stockpile sites.



Avoid sites under trees, telephone lines, overhead transmission lines or where overhead clearance is less than 6 metres.

Clear vegetation and rubble to 5 m beyond stockpile boundary and ensure that the site is self draining.

Construct gravel foundation for stockpiles with 100 mm compacted thickness. Trim and compact to 95% relative compaction.

Construct stockpiles at least 1 metre high and batter sides 1 vertical to 1.5 horizontal and trim neatly to facilitate measurement.

Remove from site any non-conforming aggregate.

53.23.3.6 Mix Requirements

53.23.3.6.1 GENERAL

Blend the bitumen emulsion with the mineral aggregate and filler in the proportions, by dry mass of aggregate, including filler, to give the required bitumen content of the slurry surfacing mix as specified in the STANDARD MIXES TABLE.

Add sufficient water to provide a mix of workable consistency and this may be varied slightly to suit the surface texture of the pavement and the pavement temperature.

53.23.3.6.2 STANDARD MIXES - TABLE

SIEVE SIZE MM	PERCENTAGE OF MINERAL AGGREGATE PASSING SIEVE BY MASS	
	NOMINAL MIX SIZE	
	7 MM	5 MM
13.2	100	100
9.5	100	100
6.7	85-100	100
4.75	70-90	90-100
2.36	45-70	50-70
1.18	28-50	35-50
0.60	19-34	20-35
0.30	12-25	12-25
0.15	7-18	7-18
0.075	5-15	4-10
Residual binder content as % mass of aggregate	6.5-9	7-9.5

53.23.3.6.3 SAMPLE MIXES

Make trial batches to determine the final blend of water, additive and cement to be used for the best results.



At least 14 days before commencing work, forward the details of the mix design, carried out in a NISIT registered laboratory and performed by a NISIT accredited technician, to the Engineer for endorsement. Once the mix design is endorsed by the Engineer it becomes the specified job mix.

53.23.3.6.4 DEPARTURES FROM THE JOB MIX – TABLE

The following table provides the maximum mean departures from the job mix for any day’s work:

	SIEVE SIZE IN MM	% BY MASS
Aggregate	6.7	7
	4.75	7
	2.36	5
	1.18	5
	0.60	4
	0.30	4
	0.15	3
	0.075	2
Bitumen Content		+ 1.0 - 0.5

If the mix gradings and binder content depart from the job mix by more than any of the maxima shown in the table, halt production until the mix is corrected.

53.23.4 EQUIPMENT

53.23.4.1 Mixing Machine

Use a self propelled slurry mixing machine with a continuous flow pugmill.

It shall be able to accurately proportion and deliver mineral aggregate, filler, bitumen emulsion water and additive to the mixing chamber and discharge the thoroughly mixed product on a continuous basis;

Equip with a dipstick on the emulsion and water tanks calibrated in intervals of 50 litres and on the additive tank use a dipstick calibrated in intervals of 10 litres;

Equip with a suitable fines feeder which provides an accurate metering device to introduce a predetermined amount of mineral filler into the mixer at the same time and in the same location as the mineral aggregate. Provide calibrated controls capable of accurately proportioning the materials;

Equip with a water pressure system and a fog type spray bar capable of completely fogging the road surface preceding the spreading equipment to a maximum application of 0.3 litres per square metre;

Fit with a guide arm and chain to assist the driver in following the correct line. Mount the guide arm on the driver’s side of the vehicle, forward of, and in full view of the driver.

For truck or semi-trailer mounted slurry surfacing machines, provide sufficient machine storage capacity to allow the adequate mixing and application of a minimum of 7 cubic metres of slurry mixture. This provision does not apply to continuous run slurry surfacing machines.

53.23.4.2 Spreading Equipment

Attach to the mixing machine a mechanical spreader box distributor.

Equip with flexible material in contact with the pavement surface to prevent loss of the slurry surfacing mix from the spreader;



It shall be capable of distributing the slurry surfacing mix across the width of the box without segregation or overflow;

It shall be designed for adjustment so that the required width and depth of spread are maintained on varying grades, crowns and superelevations.

It shall be capable of spreading up to 4.0 metres in width and equipped with skis or other levelling device to enable it to fill traverse depressions up to 1.5 metres across.

Equip with an adjustable steering device and a flexible strike-off.

53.23.4.3 Ancillary Plant

Provide all ancillary plant such as rotary road brooms, signs, lamps, barricades, hand squeegees, shovels, hand brooms and any other equipment necessary for the performance of the work.

53.23.5 PROCEDURE

53.23.5.1 Commencement of Work Notice

Give the Engineer at least 7 days notice of the actual date and time of the commencement of work.

53.23.5.2 Traffic Control

Take all necessary steps to ensure:

- The safety of traffic during the progress of the work until completion of the final operation or curing, whichever is the latter.
- That traffic does not damage the work on newly treated sections of pavement.

53.23.5.3 Pavement Preparation and Set Out

Immediately prior to any application of slurry surfacing mix, sweep the pavement as necessary to ensure that the surface is free of loose material, stones, dirt and foreign matter by the use of a mechanically operated rotary road broom.

Carry out additional sweeping necessary to obtain a satisfactory clean surface by hand using stiff brass or similar brooms.

Sweep the edges of the previously sealed areas to remove loose material for at least 150mm from the edge.

Remove adherent patches of foreign material from the surface of the road by steel scraper or other suitable methods. Report the existence of any large deposits of foreign material that cannot be removed by reasonable use of the mechanical broom to the Engineer prior to the commencement of spreading.

Do not commence spreading of the slurry surfacing mix until the Engineer has approved the prepared pavement.

If there is not a satisfactory edge line or centre line, place pavement marks on the surface at intervals of not more than 8 metres for the slurry surfacing machine to follow.

53.23.5.4 Slurry Surfacing Mix Application

Deposit the slurry surfacing mix into the spreading box at the optimum consistency.

Ensure sufficient mixing time to produce a complete and uniform coating of the aggregate.

Direct the mixture into the moving spreader box at a sufficient rate to maintain an ample supply across the full width of the strike-off squeegee at all times.

As necessary squirt minor amounts of water into the corners of the spreader box to overcome temporary build up of slurry surfacing mixture.



Square off the end of each run at the point where feathering commenced, ie. at that point where there is insufficient material in the spreader box to maintain the full width of spread.

Alternatively, lap the successive run by no more than 100mm, if it can be demonstrated that no loss of riding surface or fattiness will result.

Use suitable hand squeegees to spread the mix in areas inaccessible to the machine.

Make longitudinal joints coinciding with lane or centreline markings.

Use half passes and odd width passes where necessary for shape correction but do not use as the last pass of any paved area.

Do not allow excessive build up or unsightly appearance on longitudinal or traverse joints.

Ensure straight lines along kerbs and shoulders with no run off.

For pavement temperatures above 40⁰C, thoroughly wet the pavement surface and all crack faces with water immediately prior to the application of the slurry surfacing mix.

Ensure that all surfaces are uniformly damp and no free water is present on the surface or in the cracks when the slurry surfacing mix is applied.

Replace slurry surfacing damaged by unexpected rain after spreading.

53.23.5.5 Surplus, Waste and Defective Materials

Remove any bitumen emulsion which has deteriorated or become contaminated in any way. The Contractor shall bear the cost of replacing any such emulsion for use in the works.

Remove surplus materials in stockpiles and elsewhere from the job at the completion of the work.

Dispose of waste aggregate, bitumen emulsion, empty containers or other materials remaining after completion of the work in an acceptable manner and leave the work site in a neat and tidy condition.

53.23.5.6 Maintenance

Maintain the completed work in a satisfactory condition for a period of one month after completion of the whole of the work. Maintenance is limited to work which results from failures attributable to the operations of the Contractor.

53.23.5.7 Records

Record the particulars of the slurry surfacing work, as required by the Engineer, on the Department's standard "Daily Record Sheet – Slurry Surfacing".

Record the details of aggregate, added filler, emulsion and additive used together with the length and width of run immediately each run is completed.

Forward the original copy of the slurry surfacing Daily Record Sheet to the Engineer daily.

53.23.6 SAMPLING AND TESTING

The Contractor will be responsible for process control testing. The Contractor shall retain copies of his supplier's QC testing results, and undertake the quality control testing and inspections as required by its QC Programme. The Contractor shall make available, all QC test and inspections results when requested by the Engineer. The Contractor shall supply material samples to the Engineer for QA (Audit) testing purposes when requested.

When required by the Engineer the Contractor will carry out conformance testing through a NISIT registered Laboratory and a NISIT accredited Technician.

The NISIT registered Laboratory shall:

- take random samples of the mixed material during each days production;



- Test the samples and provide the test results to the Engineer and Contractor.

Should the Engineer identify excess aggregate loss from the surface after the slurry has fully cured, and the mix proportions are within the specified limits, suspend the work until the following tests are taken and the problems identified:

- Wet stripping test: ISSA TB 114 Minimum 90% Coating.
- Wet track abrasion test: SST 04 Maximum 800g/m² Loss.

Do not recommence spreading of the slurry surfacing mix until the Engineer has approved a new mix design which achieves compliance to the above limits.

53.23.7 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer. To be acceptable, the area designated for treatment must be 100% uniformly sealed at the specified application rate.

The Contractor shall re-treat any deficient areas at his expense.

53.23.8 MEASUREMENT AND PAYMENT

Measurement will be made in square metres of the area treated with a Slurry Surfacing.

Payment will be made at the unit price bid per square metre for " Slurry Surfacing @ 9mm thickness". This payment will be full compensation for surface preparation, the supply and laying of slurry surfacing mix, and all labour, equipment, tools and incidentals necessary to complete the Work.

Payment for any required cleaning of the roadway surface will be made in accordance with Specification 53.17, Roadway and Raised Median Cleaning.

53.23.9 WARRANTY

The warranty period for this Work shall be 30 days.



53.24 SEALED PAVEMENT RECONSTRUCTION PATCHING

53.24.1 GENERAL

The Work consists of repairs and minor rehabilitation to existing bituminous surfaces and pavements with asphalt, and includes repairs with profiling, dig-out and/or squaring up, it may be confined to the surface course or extend through all courses.

53.24.2 STANDARDS

Conform to the following Standards and Publications unless specified otherwise:

PNGS 1185	Methods for Sampling and Testing Aggregate.
AS 1160	Bitumen Emulsion for Construction and Maintenance of Pavements.
AS 1348.1	Road and Traffic Engineering: Part 1 Road Design and Construction.
PNGS 1373	Residual Bitumen for Pavements.
AS 2150	Hot mix Asphalt.
PNGS 1374	Cut Back Bitumen.
AS 2357	Mineral Fillers for Asphalt.
AS 2758.5	Aggregates and Rock for Engineering Purposes: Asphalt Aggregates.
AS 2891	Methods of Sampling and Testing Asphalt.
AS 4283	Cold Mix Asphalt for Maintenance Patching
AUSTROADS	A Guide to the Visual Assessment of Pavement Conditions
AUSTROADS	AP-G66/02 : Asphalt Guide
NAASRA	Bituminous Surfacing Volume 2 Asphalt Work 1984.

53.24.3 MATERIALS

The Contractor shall supply reconstruction patch material, satisfactory to the Engineer.

53.24.3.1 Aggregates

The combined particle size distribution to be in accordance with the tables MIX PROPORTIONS.

53.24.3.1.1 COARSE AGGREGATES

Ensure that coarse aggregates are clean, hard, high strength, angular, skid resistant, durable crushed stone of uniform quality and free from laminated particles, clay and other aggregations of fine material, soil, organic matter and any other deleterious material. Conform to the following:

Proportion of misshapen particles: 15% maximum at 2:1 caliper ratio.

Los Angeles Abrasion

- Fine grained aggregate: 30% maximum loss.
- Coarse grained aggregate: 35% maximum loss.

Sulphate Soundness: 12% maximum loss.

Polished Aggregate Friction Value: 45 minimum.



53.24.3.1.2 FINE AGGREGATES

Ensure that fine aggregates are clean, hard, sharp, washed, durable natural sand and/or material manufactured from crushed stone of uniform quality and free from clay and other aggregations of fine material, soil, organic matter and any other deleterious material.

53.24.3.2 **Mineral Filler**

A finely divided mineral material, hydrated lime or cement with a particle size smaller than 0.075 mm.

Use filler that is dry, free from lumps, clay, organic material or any other deleterious material, and complies in all other respects with the requirements of AS 2357.

53.24.3.3 **Bituminous Binder**

A straight run bitumen Class 170 or Class 320.

53.24.3.4 **Bitumen Emulsion**

A rapid setting bitumen emulsion made with bitumen Class 170 or Class 320.

53.24.3.5 **Additive**

An additive may be proposed provided that full details of the type of additive are provided and the mix design standards of the PROPORTIONING OF MIXES Clause are attained.

53.24.3.6 **Proportioning of Mixes For Hot Mix Asphalt**

53.24.3.6.1 MIX TYPE FOR HOT MIX ASPHALT

The Contract will specify Rural and/or Urban Mix Type Number to be applied.

53.24.3.6.2 MANUFACTURE OF HOT MIX ASPHALT

Mix in a plant capable of producing asphalt that complies with the approved design mix.

Bitumen temperature: 135 deg. C to 160 deg. C prior to mixing.

Heat aggregates to such a temperature that when filler and binder are added, the temperature of the mixed asphalt is between 135 deg. C and 170 deg. C.

53.24.3.6.3 MIX ASSESSMENT AND APPROVAL OF HOT MIX ASPHALT TYPES

Upon request by the Engineer, provide a minimum of 3 Marshall test results of a job mix and submit to the Engineer the following:

- A statement detailing the combined aggregate/filler grading and binder content of the design mix, and the proportion of each constituent material in the design mix.
- Samples of the constituent materials in the design mix, and
- Details of the type of additive/s if any, and its proportion within the mix.

Upon request by the Engineer, provide sample quantities as listed in the Table - CONSTITUENT MATERIAL SAMPLE QUANTITIES FOR HOT MIX ASPHALT.



53.24.3.6.4 TABLE - CONSTITUENT MATERIAL SAMPLE QUANTITIES FOR HOT MIX ASPHALT

Material	Sample Quantity
Binder	15 litres
Coarse Aggregate	
- Each constituent material nominal size $\geq 10\text{mm}$	100 kg
- Each constituent material nominal size $< 10\text{mm}$	75 kg
Fine Aggregate - each constituent material	50 kg
Added Filler	5 kg
Additive	As requested - sufficient for job mix verification

At the discretion of the Engineer, the submitted samples will be dispatched to an appropriate asphalt testing laboratory for Level 1 and Level 3 testing, as per the procedures of AP-G66/02 (Asphalt Guide).

Using the samples of constituent materials submitted, the proposed design mix may be assessed for compliance with the requirements of Clauses, PROPERTIES, TABLE – MIX PROPORTIONS and TOLERANCES. The proposed job mix shall have a maximum Wheel Tracking Rate of 0.35mm per 1,000 passes at design air voids for urban work, and 0.45mm per 1,000 passes at design air voids for rural work, as determined by the Wheel Tracking test defined in AP-G66/02 (Asphalt Guide). The Wheel Tracking Rate is the slope of the rut depth versus number of passes curve between 4,000 and 10,000 passes. Adjust the proposed mix design as required to satisfy the specified requirements.

The Combined aggregate/filler grading of the approved job mix will be termed the Approved Job Grading. The binder content of the approved job mix will be termed the Approved Job Binder Content.

Failure of submitted samples of constituent materials or the job mix to comply with the requirements specified herein will result in rejection of the job mix. In this case, submit a revised job mix design.

53.24.3.6.5 PROPERTIES OF HOT MIX ASPHALT

Conform to the following mix requirements:

MARSHALL CHARACTERISTICS	RURAL	URBAN
Compactive effort (number of blows each end of specimen):	50	75
Stability of mix (kN):	5 minimum	8 minimum
Flow (mm):	2 – 5	2 – 5
Air voids (%):	3 – 7	3 – 7
Voids in mineral aggregate (%):	14 minimum	14 minimum

Conform to the following target mix proportions and properties;



53.24.3.6.5 TABLE – MIX PROPORTIONS

Mix Type	HM 1	HM 2	HM 3	HM 4	HM 5	HM 6
	DENSE GRADED			OPEN GRADED		
	% PASSING (DRY MASS)					
AS SIEVE (mm)	5 mm	10 mm	14 mm	20 mm	10 mm	20 mm
53.0						
37.5						
26.5				100		100
19.0			100	95 – 100		95 - 100
13.2		100	85 – 100	75 – 90	100	80 - 90
9.5		90 - 100	70 – 85	60 – 80	90 - 100	65 - 80
6.7	100	70 - 90	62 – 75	50 – 70	40 - 70	52 - 65
4.75	85 - 100	58 - 76	53 – 70	40 – 60	30 - 50	45 - 55
2.36	55 - 75	40 - 58	35 – 52	25 – 43	10 - 30	30 - 43
1.18	38 - 57	27 - 44	24 – 40	18 – 35	5 - 20	20 - 35
0.60	26 - 43	17 - 35	15 – 30	14 – 27	0 - 15	14 - 27
0.30	15 - 28	11 - 24	10 – 24	9 – 21	0 - 10	9 - 21
0.15	8 - 18	7 - 16	7 – 16	6 – 15	0 - 7	7 - 15
0.075	4 - 11	4 - 7	4 – 7	3 – 7	0 - 4	3 - 6
Bitumen binder (% by mass)	5.0 - 7.0	4.5 - 6.5	4.6 - 6.5	4.0 – 6.0	3.5 – 5.5	3.5 - 5.5
Compacted thickness (mm)	10 - 25	25 - 40	35 – 55	50 – 80	25 - 40	50 - 80
Bitumen film thickness (min micron)	8.5	8.5	8.5	8.5	8.5	8.5

The grading curve shall be smooth and shall not vary from the outer one third of the range between the specified limits for one sieve size to the opposite outer one third of the range between the specified limits for an adjacent sieve size.

53.24.3.7 Proportioning Of Mixes For Cold Mix Asphalt

53.24.3.7.1 MIX TYPE FOR COLD MIX ASPHALT

The Contract will specify the Mix Type Number to be applied.

53.24.3.7.2 MANUFACTURE OF COLD MIX ASPHALT

Dry mix aggregate and mineral filler to provide a homogenous blend.

Add bituminous binder until the specified percentage is reached.

Carry out further mixing until a minimum of 90% of the coarse aggregate particles are coated.

Add additional bitumen so that a satisfactory mix can be achieved, if so directed by the Superintendent.

Conform to the following mix proportions;



53.24.3.7.3 TABLE – AGGREGATE AND MINERAL FILLER MIX PROPORTIONS

Mix Type	CM 1	CM 2	CM 3	CM 4	CM 5	CM 6	CM 7	CM 8
	DENSE GRADED				OPEN GRADED			
	% PASSING (DRY MASS)							
AS SIEVE (mm)	7 mm	10 mm	14 mm	20 mm	7 mm	10 mm	14 mm	20 mm
53.0								
37.5								
26.5				100				100
19.0			100	95 – 100			100	95 - 100
13.2		100	85 - 100			100	90 - 100	50 – 90
9.5	100	90 - 100	70 - 85	58 – 74	100	90 - 100	40 - 75	30 – 65
6.7	90 - 100			45 – 60	85 - 100	30 - 75	10 - 35	10 – 35
4.75	70 - 90	58 - 70	46 - 65	37 – 50	30 - 70	20 - 55	5 - 25	5 – 25
2.36	45 - 60	35 - 50	28 - 45	22 – 36	10 - 40	5 - 30	0 - 10	0 – 10
1.18		22 - 38	15 - 30	12 – 26	0 – 20	0 - 10		
0.60	15 - 30	12 - 27	10 - 23	6 – 20	0 – 10			
0.30	10 - 20	6 - 16	5 - 17	4 – 15				
0.15	4 - 14	4 - 14	3 - 11	2 – 10				
0.075	3 - 8	2 - 6	2 - 5	1 – 5	0 – 4	0 - 4	0 - 4	0 – 4
Total %	100	100	100	100	100	100	100	100

The grading curve shall be smooth and shall not vary from the outer one third of the range between the specified limits for one sieve size to the opposite outer one third of the range between the specified limits for an adjacent sieve size.

53.24.3.7.4 TABLE – TOTAL MIX PROPORTIONS OF COLD MIX ASPHALT

Mix Type	CM 1	CM 2	CM 3	CM 4	CM 5	CM 6	CM 7	CM 8
	DENSE GRADED				OPEN GRADED			
SIZE	7 mm	10 mm	14 mm	20 mm	7 mm	10 mm	14 mm	20 mm
Material	% OF TOTAL MIX							
Aggregate and filler %	94.2 – 95.2	94.8 – 95.8	95.0 – 96.0	95.3 – 96.3	95.0 – 96.0	95.5 – 96.5	95.5 – 96.5	96.0 – 97.0
Residual binder %	4.8 – 5.8	4.2 – 5.2	4.0 – 5.0	3.7 – 4.7	4.0 – 5.0	3.5 – 4.5	3.5 – 4.5	3.0 – 4.0
Total Mix %	100	100	100	100	100	100	100	100



53.24.3.7.5 SPECIFICATION LIMITS FOR THE BINDER MIX OF COLD MIX ASPHALT

Bitumen;	100 parts
Flux;	Between 5 and 15 parts, depending on location and climatic conditions. Will be specified by the Engineer
Cutter;	10 parts

53.24.4 PROCEDURES

This Procedure applies to patch defect areas requiring squaring up and or the removal of distressed pavement.

Prior to the commencement of any pavement works, the Contractor is to confirm and agree with the Engineer, the location and extent of each “Reconstruction Patch” repair to be conducted.

The Contract will specify the suitable type and size of hot mix asphalt or cold mix asphalt for patch material.

The pavement areas to be repaired shall be excavated to the required depth below the existing pavement level, and remove and dispose excavated pavement material to an approved dump location. Excavate with the use of reclaimer/profiler plant, where appropriate.

Cut back the edges of the hole to sound material, cut the side vertically in order to provide shoulders against the movement of the patch, and square the bottom.

Square up the surface shape of the patch to provide a neat appearance.

Clean excavation of all loose aggregate, dust and water.

Thoroughly compact exposed formation in readiness to receive the patch material.

Apply a tack coat to the sides and bottom of the hole. Avoid applying too much tack coat so as not to induce a condition known as a fatty patch.

Supply, place, spread and compact the asphalt in layers in the hole until finished surface is flush with existing surface.

Compact in layers approximately 2.5 times the nominal size of the mix aggregate and bring up to surface in layers level with the intended surface profile.

Depending on the size of the patch, level by hand raking, a pull type drag, or paver.

Remove all aggregate larger than the feather edge so that the edges of the patch can be raked and rolled to a smooth junction with the old surface.

Compact larger patches with a small vibrating roller.

Remove all waste materials from the road reserve and dispose at an approved dump area. Waste stock piles are not permitted for any duration.

53.24.5 SAMPLING AND TESTING

The Contractor shall retain copies of his supplier’s QC testing results, and undertake the quality control testing and inspections as required by its QC Programme. The Contractor shall make available, all QC test and inspections results when requested by the Engineer. The Contractor shall supply material samples to the Engineer for QA (Audit) testing purposes when requested.



53.24.6 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer. To be acceptable, patches must provide a dense, smooth and level transition between the treated area and the adjacent undisturbed pavement surface. Any loose material must be removed and the site left in a clean condition.

The Contractor shall re-treat any failed areas at his expense.

53.24.7 MEASUREMENT AND PAYMENT

The unit of measurement for “**Reconstruction Patching**” shall be the plan area, in square metres, to the extent as agreed to under Sub-Clause 53.24.4. The Contractor shall not be paid for any works constructed in excess of the agreed extent.

Payment shall be made at the billed rate for “**Reconstruction Patching**” and shall include all work necessary to prepare the patch area(s), supply, place and compact patch material to patch areas, to existing road levels.

The Contractor shall be responsible for all costs associated with the supply, delivery and construction of patch materials including any royalty payments for materials extracted from approved quarries.

53.24.8 WARRANTY

The warranty period for this Work shall be 90 days.



53.25 SEALED PAVEMENT REGULATION PATCHING

53.25.1 GENERAL

The Work consists of Surface repairs and shape correction without dig-out and/or squaring up, will usually not be straight sided due to irregularities in the pavement and feathering repair techniques.

53.25.2 STANDARDS

Conform to the following Standards and Publications unless specified otherwise:

PNGS 1185	Methods for Sampling and Testing Aggregate.
AS 1160	Bitumen Emulsion for Construction and Maintenance of Pavements.
AS 1348.1	Road and Traffic Engineering: Part 1 Road Design and Construction.
PNGS 1373	Residual Bitumen for Pavements.
AS 2150	Hot mix Asphalt.
PNGS 1374	Cut Back Bitumen.
AS 2357	Mineral Fillers for Asphalt.
AS 2758.5	Aggregates and Rock for Engineering Purposes: Asphalt Aggregates.
AS 2891	Methods of Sampling and Testing Asphalt.
AS 4283	Cold Mix Asphalt for Maintenance Patching
AUSTROADS	A Guide to the Visual Assessment of Pavement Conditions
AUSTROADS	AP-G66/02: Asphalt Guide
NAASRA	Bituminous Surfacing Volume 2 Asphalt Work 1984.

53.25.3 MATERIALS

The Contractor shall supply patch material satisfactory to the Engineer. Preparation and application of approved commercially produced proprietary patch materials shall closely follow manufacturer's instructions.

53.25.3.1 Aggregates

The combined particle size distribution to be in accordance with the tables MIX PROPORTIONS.

53.25.3.1.1 COARSE AGGREGATES

Ensure that coarse aggregates are clean, hard, high strength, angular, skid resistant, durable crushed stone of uniform quality and free from laminated particles, clay and other aggregations of fine material, soil, organic matter and any other deleterious material. Conform to the following:

Proportion of misshapen particles: 15% maximum at 2:1 caliper ratio.

Los Angeles Abrasion

- Fine grained aggregate: 30% maximum loss.
- Coarse grained aggregate: 35% maximum loss.
- Sulphate Soundness: 12% maximum loss.

Polished Aggregate Friction Value: 45 minimum.



53.25.3.1.2 FINE AGGREGATES

Ensure that fine aggregates are clean, hard, sharp, washed, durable natural sand and/or material manufactured from crushed stone of uniform quality and free from clay and other aggregations of fine material, soil, organic matter and any other deleterious material.

53.25.3.2 Mineral Fillers

A finely divided mineral material, hydrated lime or cement with a particle size smaller than 0.075 mm.

Use filler that is dry, free from lumps, clay, organic material or any other deleterious material, and complies in all other respects with the requirements of AS 2357.

53.25.3.3 Bituminous Binder

A straight run bitumen Class 170 or Class 320.

53.25.3.4 Bitumen Emulsion

A rapid setting bitumen emulsion made with bitumen Class 170 or Class 320.

53.25.3.5 Additive

An additive may be proposed provided that full details of the type of additive are provided and the mix design standards of the PROPORTIONING OF MIXES Clause are attained.

53.25.3.6 Proportioning Of Mixes For Hot Mix Asphalt

53.25.3.6.1 MIX TYPE FOR HOT MIX ASPHALT

The Contract will specify Rural and/or Urban Mix Type Number to be applied.

53.25.3.6.2 MANUFACTURE OF HOT MIX ASPHALT

Mix in a plant capable of producing asphalt that complies with the approved design mix.

Bitumen temperature: 135 deg. C to 160 deg. C prior to mixing.

Heat aggregates to such a temperature that when filler and binder are added, the temperature of the mixed asphalt is between 135 deg. C and 170 deg. C.

53.25.3.6.3 MIX ASSESSMENT AND APPROVAL OF HOT MIX ASPHALT TYPES

Upon request by the Engineer, provide a minimum of 3 Marshall test results of a job mix and submit to the Engineer the following:

- A statement detailing the combined aggregate/filler grading and binder content of the design mix, and the proportion of each constituent material in the design mix.
- Samples of the constituent materials in the design mix, and
- Details of the type of additive/s if any, and its proportion within the mix.

Upon request by the Engineer, provide sample quantities as listed in the Table - CONSTITUENT MATERIAL SAMPLE QUANTITIES FOR HOT MIX ASPHALT.



53.25.3.6.4 TABLE - CONSTITUENT MATERIAL SAMPLE QUANTITIES FOR HOT MIX ASPHALT

Material	Sample Quantity
Binder	15 litres
Coarse Aggregate	
- Each constituent material nominal size $\geq 10\text{mm}$	100 kg
- Each constituent material nominal size $< 10\text{mm}$	75 kg
Fine Aggregate - each constituent material	50 kg
Added Filler	5 kg
Additive	As requested - sufficient for job mix verification

At the discretion of the Engineer, the submitted samples will be dispatched to an appropriate asphalt testing laboratory for Level 1 and Level 3 testing, as per the procedures of AP-G66/02 (Asphalt Guide).

Using the samples of constituent materials submitted, the proposed design mix may be assessed for compliance with the requirements of Clauses, PROPERTIES, TABLE – MIX PROPORTIONS and TOLERANCES. The proposed job mix shall have a maximum Wheel Tracking Rate of 0.35mm per 1,000 passes at design air voids for urban work, and 0.45mm per 1,000 passes at design air voids for rural work, as determined by the Wheel Tracking test defined in AP-G66/02. The Wheel Tracking Rate is the slope of the rut depth versus number of passes curve between 4,000 and 10,000 passes. Adjust the proposed mix design as required to satisfy the specified requirements.

The Combined aggregate/filler grading of the approved job mix will be termed the Approved Job Grading. The binder content of the approved job mix will be termed the Approved Job Binder Content.

Failure of submitted samples of constituent materials or the job mix to comply with the requirements specified herein will result in rejection of the job mix. In this case, submit a revised job mix design.

53.25.3.6.5 PROPERTIES OF HOT MIX ASPHALT

Conform to the following mix requirements:

MARSHALL CHARACTERISTICS	RURAL	URBAN
Compactive effort (number of blows each end of specimen):	50	75
Stability of mix (kN):	5 minimum	8 minimum
Flow (mm):	2 – 5	2 – 5
Air voids (%):	3 – 7	3 – 7
Voids in mineral aggregate (%):	14 minimum	14 minimum

Conform to the following target mix proportions and properties;



53.25.3.6.6 **TABLE – MIX PROPORTIONS**

Mix Type	HM 1	HM 2	HM 3	HM 4	HM 5	HM 6
	DENSE GRADED			OPEN GRADED		
	% PASSING (DRY MASS)					
AS SIEVE (mm)	5 mm	10 mm	14 mm	20 mm	10 mm	20 mm
53.0						
37.5						
26.5				100		100
19.0			100	95 – 100		95 - 100
13.2		100	85 – 100	75 – 90	100	80 - 90
9.5		90 - 100	70 – 85	60 – 80	90 - 100	65 - 80
6.7	100	70 - 90	62 – 75	50 – 70	40 - 70	52 - 65
4.75	85 - 100	58 - 76	53 – 70	40 – 60	30 - 50	45 - 55
2.36	55 - 75	40 - 58	35 – 52	25 – 43	10 - 30	30 - 43
1.18	38 - 57	27 - 44	24 – 40	18 – 35	5 - 20	20 - 35
0.60	26 - 43	17 - 35	15 – 30	14 – 27	0 - 15	14 - 27
0.30	15 - 28	11 - 24	10 – 24	9 – 21	0 - 10	9 - 21
0.15	8 - 18	7 - 16	7 – 16	6 – 15	0 - 7	7 - 15
0.075	4 - 11	4 - 7	4 – 7	3 – 7	0 - 4	3 - 6
Bitumen binder (% by mass)	5.0 - 7.0	4.5 - 6.5	4.6 - 6.5	4.0 – 6.0	3.5 – 5.5	3.5 - 5.5
Compacted thickness (mm)	10 - 25	25 - 40	35 – 55	50 – 80	25 - 40	50 - 80
Bitumen film thickness (min micron)	8.5	8.5	8.5	8.5	8.5	8.5

The grading curve shall be smooth and shall not vary from the outer one third of the range between the specified limits for one sieve size to the opposite outer one third of the range between the specified limits for an adjacent sieve size.

53.25.3.7 Proportioning Of Mixes For Cold Mix Asphalt

53.25.3.7.1 MIX TYPE FOR COLD MIX ASPHALT

The Contract will specify the Mix Type Number to be applied.

53.25.3.7.2 MANUFACTURE OF COLD MIX ASPHALT

Dry mix aggregate and mineral filler to provide a homogenous blend.

Add bituminous binder until the specified percentage is reached.

Carry out further mixing until a minimum of 90% of the coarse aggregate particles are coated.

Add additional bitumen so that a satisfactory mix can be achieved, if so directed by the Superintendent.

Conform to the following mix proportions;



53.25.3.7.3 **TABLE – AGGREGATE AND MINERAL FILLER MIX PROPORTIONS**

Mix Type	CM 1	CM 2	CM 3	CM 4	CM 5	CM 6	CM 7	CM 8
	DENSE GRADED				OPEN GRADED			
	% PASSING (DRY MASS)							
AS SIEVE (mm)	7 mm	10 mm	14 mm	20 mm	7 mm	10 mm	14 mm	20 mm
53.0								
37.5								
26.5				100				100
19.0			100	95 – 100			100	95 - 100
13.2		100	85 - 100			100	90 - 100	50 – 90
9.5	100	90 - 100	70 - 85	58 – 74	100	90 - 100	40 - 75	30 – 65
6.7	90 - 100			45 – 60	85 - 100	30 - 75	10 - 35	10 – 35
4.75	70 - 90	58 - 70	46 - 65	37 – 50	30 - 70	20 - 55	5 - 25	5 – 25
2.36	45 - 60	35 - 50	28 - 45	22 – 36	10 - 40	5 - 30	0 - 10	0 – 10
1.18		22 - 38	15 - 30	12 – 26	0 – 20	0 - 10		
0.60	15 - 30	12 - 27	10 - 23	6 – 20	0 – 10			
0.30	10 - 20	6 - 16	5 - 17	4 – 15				
0.15	4 - 14	4 - 14	3 - 11	2 – 10				
0.075	3 - 8	2 - 6	2 - 5	1 – 5	0 – 4	0 - 4	0 - 4	0 – 4
Total %	100	100	100	100	100	100	100	100

The grading curve shall be smooth and shall not vary from the outer one third of the range between the specified limits for one sieve size to the opposite outer one third of the range between the specified limits for an adjacent sieve size.

53.25.3.7.4 **TABLE – TOTAL MIX PROPORTIONS OF COLD MIX ASPHALT**

Mix Type	CM 1	CM 2	CM 3	CM 4	CM 5	CM 6	CM 7	CM 8
	DENSE GRADED				OPEN GRADED			
SIZE	7 mm	10 mm	14 mm	20 mm	7 mm	10 mm	14 mm	20 mm
Material	% OF TOTAL MIX							
Aggregate and filler %	94.2 – 95.2	94.8 – 95.8	95.0 – 96.0	95.3 – 96.3	95.0 – 96.0	95.5 – 96.5	95.5 – 96.5	96.0 – 97.0
Residual binder %	4.8 - 5.8	4.2 - 5.2	4.0 - 5.0	3.7 - 4.7	4.0 - 5.0	3.5 - 4.5	3.5 - 4.5	3.0 - 4.0
Total Mix %	100	100	100	100	100	100	100	100



53.25.3.7.5 SPECIFICATION LIMITS FOR THE BINDER MIX OF COLD MIX ASPHALT

Bitumen;	100 parts
Flux;	Between 5 and 15 parts, depending on location and climatic conditions. Will be specified by the Engineer
Cutter;	10 parts

53.25.4 PROCEDURES

This procedure applies to patch defect areas where only the surface needs repair.

Prior to the commencement of any pavement works, the Contractor is to confirm and agree with the Engineer, the number, sizes and extent of “Regulation Patch” repairs to be conducted.

The Contract will specify the suitable type of hot mix asphalt or cold mix asphalt for the patch material.

Remove all debris and any loose materials on the pavement.

Repair any potholes or cracks as required, refer to other Specifications.

Apply a tack coat to the area under repair at the application rate to suit surface conditions.

Supply, place, spread and compact the asphalt in layers until finished surface is flush with the existing surface.

Compact in layers approximately 2.5 times the nominal size of the mix aggregate and bring up to surface in layers level with the intended surface profile.

Compact smaller holes with vibrating plate compactor and/or mechanical tampers.

Compact larger patches with a small vibrating roller.

Depending on the size of the patch, level by hand raking, a pull type drag, or paver.

Remove all aggregate larger than the feather edge so that the edges of the patch can be raked and rolled to a smooth junction with the old surface.

Brush off and remove all loose material from area.

53.25.5 SAMPLING AND TESTING

The Contractor shall retain copies of his supplier’s QC testing results, and undertake the quality control testing and inspections as required by its QC Programme. The Contractor shall make available, all QC test and inspections results when requested by the Engineer. The Contractor shall supply material samples to the Engineer for QA (Audit) testing purposes when requested.

53.25.6 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer. To be acceptable, patches must provide a dense, smooth and level transition between the treated area and the adjacent undisturbed pavement surface. Any loose material must be removed and the site left in a clean condition.

The Contractor shall re-treat any failed areas at his expense.



53.25.7 MEASUREMENT AND PAYMENT

The unit of measurement for “**Regulation Patching**” shall be the plan area, in square metres, to the extent as agreed to under Sub-Clause 53.25.4. The Contractor shall not be paid for any works constructed in excess of the agreed extent.

Payment shall be made at the billed rate for “**Regulation Patching**” and shall include all work necessary to prepare the patch area(s), supply, place and compact patch material to patch areas, to existing road levels.

The Contractor shall be responsible for all costs associated with the supply, delivery and construction of patch materials including any royalty payments for materials extracted from approved quarries.

53.25.8 WARRANTY

The warranty period for this Work shall be 90 days.



53.26 ASPHALT PAVEMENT SURFACE MAINTENANCE

53.26.1 GENERAL

The Work consists of spreading and compacting Hot Mixed Asphalt by means of paver machine, or hand on a prepared pavement surface.

53.26.2 STANDARDS

Conform to the following Standards and Publications unless specified otherwise:

PNGS 1185	Methods for Sampling and Testing Aggregate.
AS 1160	Bitumen Emulsion for Construction and Maintenance of Pavements.
AS 1348.1	Road and Traffic Engineering: Part 1 Road Design and Construction.
PNGS 1373	Residual Bitumen for Pavements.
AS 2150	Hot mix Asphalt.
PNGS 1374	Cut Back Bitumen.
AS 2357	Mineral Fillers for Asphalt.
AS 2758.5	Aggregates and Rock for Engineering Purposes: Asphalt Aggregates.
AS 2891	Methods of Sampling and Testing Asphalt.
AUSTROADS	A Guide to the Visual Assessment of Pavement Conditions
AUSTROADS	AP-G66/02: Asphalt Guide
NAASRA	Bituminous Surfacing Volume 2 Asphalt Work 1984.

53.26.3 MATERIALS

Hot Mix Asphalt concrete patching material supplied by the Contractor shall conform to the material requirements below.

53.26.3.1 Aggregates

The combined particle size distribution to be in accordance with the tables MIX PROPORTIONS.

53.26.3.1.1 COARSE AGGREGATES

Ensure that coarse aggregates are clean, hard, high strength, angular, skid resistant, durable crushed stone of uniform quality and free from laminated particles, clay and other aggregations of fine material, soil, organic matter and any other deleterious material. Conform to the following:

Proportion of misshapen particles: 15% maximum at 2:1 caliper ratio.

Los Angeles Abrasion

- Fine grained aggregate: 30% maximum loss.
- Coarse grained aggregate: 35% maximum loss.

Sulphate Soundness: 12% maximum loss.

Polished Aggregate Friction Value: 45 minimum.



53.26.3.1.2 FINE AGGREGATES

Ensure that fine aggregates are clean, hard, sharp, washed, durable natural sand and/or material manufactured from crushed stone of uniform quality and free from clay and other aggregations of fine material, soil, organic matter and any other deleterious material.

53.26.3.2 Mineral Filler

A finely divided mineral material, hydrated lime or cement with a particle size smaller than 0.075 mm.

Use filler that is dry, free from lumps, clay, organic material or any other deleterious material, and complies in all other respects with the requirements of AS 2357.

53.26.3.3 Bituminous Binder

A straight run bitumen Class 170 or Class 320.

53.26.3.4 Bitumen Emulsion

A rapid setting bitumen emulsion made with bitumen Class 320.

53.26.3.5 Additive

An additive may be proposed provided that full details of the type of additive are provided and the mix design standards of the PROPORTIONING OF MIXES Clause are attained.

53.26.3.6 Proportioning Of Mixes For Hot Mix Asphalt

53.26.3.6.1 MIX TYPE FOR HOT MIX ASPHALT

The Contract will specify Rural and/or Urban Mix Type Number to be applied.

53.26.3.6.2 MANUFACTURE OF HOT MIX ASPHALT

Mix in a plant capable of producing asphalt that complies with the approved design mix.

Bitumen temperature: 135 deg. C to 160 deg. C prior to mixing.

Heat aggregates to such a temperature that when filler and binder are added, the temperature of the mixed asphalt is between 135 deg. C and 170 deg. C.

53.26.3.6.3 MIX ASSESSMENT AND APPROVAL OF HOT MIX ASPHALT TYPES

Upon request by the Engineer, provide a minimum of 3 Marshall test results of a job mix and submit to the Engineer the following:

- A statement detailing the combined aggregate/filler grading and binder content of the design mix, and the proportion of each constituent material in the design mix.
- Samples of the constituent materials in the design mix, and
- Details of the type of additive/s if any, and its proportion within the mix.

Upon request by the Engineer, provide sample quantities as listed in the Table - CONSTITUENT MATERIAL SAMPLE QUANTITIES FOR HOT MIX ASPHALT.



53.26.3.6.4 TABLE - CONSTITUENT MATERIAL SAMPLE QUANTITIES FOR HOT MIX ASPHALT

Material	Sample Quantity
Binder	15 litres
Coarse Aggregate	
- Each constituent material nominal size $\geq 10\text{mm}$	100 kg
- Each constituent material nominal size $< 10\text{mm}$	75 kg
Fine Aggregate - each constituent material	50 kg
Added Filler	5 kg
Additive	As requested - sufficient for job mix verification

At the discretion of the Engineer, the submitted samples will be dispatched to an appropriate asphalt testing laboratory for Level 1 and Level 3 testing, as per the procedures of AP-G66/02 (Asphalt Guide).

Using the samples of constituent materials submitted, the proposed design mix may be assessed for compliance with the requirements of Clauses, PROPERTIES, TABLE – MIX PROPORTIONS and TOLERANCES. The proposed job mix shall have a maximum Wheel Tracking Rate of 0.35mm per 1,000 passes at design air voids for urban work, and 0.45mm per 1,000 passes at design air voids for rural work, as determined by the Wheel Tracking test defined in AP-G66/02. The Wheel Tracking Rate is the slope of the rut depth versus number of passes curve between 4,000 and 10,000 passes. Adjust the proposed mix design as required to satisfy the specified requirements.

The Combined aggregate/filler grading of the approved job mix will be termed the Approved Job Grading. The binder content of the approved job mix will be termed the Approved Job Binder Content.

Failure of submitted samples of constituent materials or the job mix to comply with the requirements specified herein will result in rejection of the job mix. In this case, submit a revised job mix design.

53.26.3.6.5 PROPERTIES OF HOT MIX ASPHALT

Conform to the following mix requirements:

MARSHALL CHARACTERISTICS	RURAL	URBAN
Compactive effort (number of blows each end of specimen):	50	75
Stability of mix (kN):	5 minimum	8 minimum
Flow (mm):	2 – 5	2 – 5
Air voids (%):	3 – 7	3 – 7
Voids in mineral aggregate (%):	14 minimum	14 minimum

Conform to the following target mix proportions and properties;



53.26.3.6.6 TABLE– MIX PROPORTIONS

Mix Type	HM 1	HM 2	HM 3	HM 4	HM 5	HM 6
	DENSE GRADED			OPEN GRADED		
	% PASSING (DRY MASS)					
AS SIEVE (mm)	5 mm	10 mm	14 mm	20 mm	10 mm	20 mm
53.0						
37.5						
26.5				100		100
19.0			100	95 – 100		95 - 100
13.2		100	85 – 100	75 – 90	100	80 - 90
9.5		90 - 100	70 – 85	60 – 80	90 - 100	65 - 80
6.7	100	70 - 90	62 – 75	50 – 70	40 - 70	52 - 65
4.75	85 - 100	58 - 76	53 – 70	40 – 60	30 - 50	45 - 55
2.36	55 - 75	40 - 58	35 – 52	25 – 43	10 - 30	30 - 43
1.18	38 - 57	27 - 44	24 – 40	18 – 35	5 - 20	20 - 35
0.60	26 - 43	17 - 35	15 – 30	14 – 27	0 - 15	14 - 27
0.30	15 - 28	11 - 24	10 – 24	9 – 21	0 - 10	9 - 21
0.15	8 - 18	7 - 16	7 – 16	6 – 15	0 - 7	7 - 15
0.075	4 - 11	4 - 7	4 – 7	3 – 7	0 - 4	3 - 6
Bitumen binder (% by mass)	5.0 - 7.0	4.5 - 6.5	4.6 - 6.5	4.0 – 6.0	3.5 – 5.5	3.5 - 5.5
Compacted thickness (mm)	10 - 25	25 - 40	35 – 55	50 – 80	25 - 40	50 - 80
Bitumen film thickness (min micron)	8.5	8.5	8.5	8.5	8.5	8.5

The grading curve shall be smooth and shall not vary from the outer one third of the range between the specified limits for one sieve size to the opposite outer one third of the range between the specified limits for an adjacent sieve size.

53.26.4 PROCEDURES

The Contract will specify the suitable type and size of hot mix asphalt for patch material.

53.26.4.1 Surface Preparation

53.26.4.1.1 EXISTING BITUMEN, CONCRETE SURFACES AND COMPACTED AND TRIMMED BASECOURSE

Remove all vegetation, loose and extraneous matter.



53.26.4.1.2 TACK COAT

Apply a fine spray of bitumen emulsion lightly and evenly over the whole of the area to be covered with asphalt.

Hand spray only in areas where it is impractical to use a spray bar.

Application rate: 0.3 – 0.6 litres/square metre.

Allow the tack coat to 'break' before laying the asphalt.

Clean and tack coat existing asphalt face against which new work is to be laid.

53.26.4.2 Transport and Supply

Insulate the bodies of trucks, block out corners with timber, and cover the body with a fitted tarpaulin when transporting distance is over 20 km or when temperatures are below 20 deg C.

53.26.4.3 Spreading and Laying

Lay the final surface layer at a uniform thickness, and as one continuous operation.

Construct a transverse joint whenever the operation ceases.

Remove from site, prior to initial rolling, asphalt which has cooled below the required initial rolling temperature.

Hand spread in locations where mechanical spreading is not practical, and to correct localised depressions or irregularities.

Take the asphalt directly from the spreader hopper or dump asphalt onto metal sheets or existing hard clean surfaces. Do not dump asphalt directly onto the area where it is to be spread.

Complete the work as one continuous operation.

Remove from site all excess or spilt asphalt.

53.26.4.3.1 MINIMUM TEMPERATURES OF HOT MIX ASPHALT

Comply with the minimum laying and initial rolling temperatures.

Cease laying asphalt during heavy or continuous rain, or in wet conditions where the material will not adhere or key to the surface.

Laying temperature: 135 deg C.

Initial rolling temperature: 105 deg C.

53.26.4.3.2 JOINTS GENERALLY

Minimise the number of longitudinal and transverse joints.

Offset joints in multiple layer work by at least 100 mm so that joints in the surface course do not overlay joints in the previous course.

Overlap the finished asphalt by 25 mm to 75 mm when spreading.

Push the overlap asphalt back immediately to form a ridge along the joint.

Roll the ridge to form a smooth joint.

Remove excess asphalt prior to final rolling.

Prevent the accumulation of coarse particles along the joint by raking.

53.26.4.3.3 TRANSVERSE JOINTS

Form by cutting the end of the spread material to a vertical face and remove loose material.

Check the surface adjacent to the joint with a straight edge and correct any surface defects immediately.



Treat the face of the joint with bitumen emulsion tack coat prior to spreading adjacent section.

Provide ramps of compacted asphalt (maximum grade 5% relative to pavement grade) when joints are left overnight on trafficked pavements.

53.26.4.3.4 LONGITUDINAL JOINTS

Keep joints straight or follow the line of curvature.

Minimise the unsupported length left overnight.

Rectify broken sections of unsupported edge by cutting a vertical face before resuming laying.

Treat the face of the joint with bitumen emulsion tack coat prior to spreading adjacent section.

Longitudinal joints shall not be left overnight on a pavement in use by traffic.

Transverse Match of Overlay to Existing Pavement:

- Saw cut existing asphalt pavement 20 mm depth along the match line of joint.
- Remove taper wedge of existing asphalt pavement along the overlay side of match joint.
- Feather the asphalt overlay down to the existing pavement to achieve a maximum slope of 1 in 40 and for the full width of the pavement.
- Ensure depth of overlay above existing pavement in taper wedge area is not less than 20 mm.

53.26.4.4 **Compaction**

53.26.4.4.1 GENERAL

For large patches, compact by using at least two rollers, one pneumatic tyred and one tandem steel wheeled.

Provide additional steel wheeled roller(s) for each additional 30 tonne (or part thereof) spread in excess of 30 tonne per hour.

Stand compaction plant clear of new asphalt surface.

Remove from site plant with fuel or oil leaks.

Defer rolling if excessive displacement of the asphalt occurs but only until the asphalt has cooled sufficiently to permit rolling to continue.

53.26.4.4.2 INITIAL ROLLING

Roll immediately behind the spreader using a steel wheeled roller having a minimum weight of 8 tonnes and a maximum unit load on the rear drum equivalent to 55kN per metre width of drum.

Provide steel wheeled rollers with adjustable scrapers and keep the drums moist with water.

Prevent the mix from sticking to the drums.

Avoid ponding of water on the pavement surface.

53.26.4.4.3 INTERMEDIATE ROLLING

Roll with a self-propelled pneumatic tyred roller of at least 10 tonnes mass, a minimum tyre pressure of 550 kPa and a minimum total load of 1 tonne on each tyre. Increase the load to 2 tonnes per tyre where practicable.

Ensure tyre pressures are uniform and maintained within 5% of the specified figure.

Rolling surfaces to be smooth.



53.26.4.4.4 FINAL ROLLING

Roll with a steel wheeled roller as used for initial rolling.

53.26.4.4.5 JOINT COMPACTION

Compact all joints and edges.

Roll all joints.

Overlap joints in adjoining runs by a minimum of 1 m.

53.26.4.4.6 ROLLING SPEED

Steel wheeled roller: 1.5 m/sec. maximum, steady and uniform.

Pneumatic tyred roller: 0.75 m/sec. Maximum for the first pas.

4.5 m/sec. Maximum for subsequent passes.

Avoid abrupt stops and starts.

53.26.4.4.7 VIBRATING PLANT

Mass:	6 tonnes minimum.
Drum width:	1.5 metres minimum.
Vibrating frequency:	2,000 – 3,000 cycles per minute.
Amplitude range:	0.4 – 8.0 mm.

Initial passes (not less than two) to be non-vibrating.

Provide steel wheeled rollers with adjustable scrapers and keep drums moist with water.

Disengage vibrator when accelerating, decelerating or standing.

53.26.4.4.8 DEEP LIFT ROLLING PATTERN

Applies to asphalt placed in layers exceeding 75 mm compacted thickness.

Asphalt to be placed and compacted in layers not exceeding 150 mm maximum.

Commence rolling not less than 300 mm clear of the edge of asphalt that is laterally unsupported.

Advance outwards towards the edge in 100 mm increments.

Delay rolling within 200 mm of an unsupported edge to allow mix cooling and minimise distortion.

Complete rolling in such time that specified densities are obtained.

53.26.4.4.9 HAND TAMPERS

Compact by vibratory plates or hand tampers in location inaccessible to rollers.

Side tamp before rolling the edge of all asphalt which is not laterally supported.

Finish hand tamped surfaces smoothly and conforming with machine finished areas.

53.26.5 SAMPLING AND TESTING

The Contractor will be responsible for process control testing. The Contractor shall retain copies of his supplier's QC testing results, and undertake the quality control testing and inspections as required by its QC Programme. The Contractor shall make available, all QC test and inspections results when requested by the Engineer. The Contractor shall supply material samples to the Engineer for QA (Audit) testing purposes when requested.



53.26.5.1 CONFORMANCE

The Contractor will be responsible for ordering the conformance tests.

53.26.5.1.1 TABLE – ASPHALT TESTING FREQUENCIES

For large patching works, conform to the following testing frequencies.

TEST METHOD NO.	TEST METHOD	MINIMUM TEST FREQUENCY
AS /N/ZS 2891.3	Bitumen content	1 per 50 t
-	Mixing temperature	Every mix
-	Laying temperature	Every 30 minutes
AS 2891	Density	1 per 50 t
AS 2891.5	Thickness	1 per density
AS /N/ZS 2891.3	Particle size distribution	1 per 50 t
AS 2341.3	Viscosity	1 per 10,000 L
AS 2891.5	Stability of mix	1 per 50 t
AS 2891.5	Flow	1 per 50 t
AS 2891.8	Air voids	1 per 50 t
AS 2891.8	Voids in mineral aggregate	1 per 50 t

53.26.5.1.2 CONFORMANCE OF COMPACTION

Base the conformance of compaction on lots, determined from cores.

Subdivide all items of work into lots.

Give each lot a lot number.

Number the lots using a logical system.

Maintain a register of all lots and lot numbers. Include the location of the lot on the lot register.

Lots of work will be selected by the Contractor, based upon:

- Lot will represent no more than one shifts production.
- Lots will be continuous and have been brought to completion at the same time.
- Lot will be composed of homogeneous material with no distinct changes in attribute values.

Each lot will be subject to conformance testing.

Lots will be checked for level tolerance.

The quality of the lot will be judged as conformance or non-conformance of each lot including all tests conducted on the lot.

When lots fail to satisfy the conformance criteria, the non-conforming lot shall be rejected and the Contractor shall re-treat the failed lot in accordance with the Acceptance Criteria Clause.

Should the lot under consideration be subdivided then class each subdivision as a lot and subject each subdivided lot to lot testing.

Treat non-conforming lots which are subdivided after testing as separate lots and retest each and every subdivided lot.



Core sample locations will be selected by the laboratory on a stratified random basis in accordance with NTCP 103.1. supply copies of the completed stratified random selection with each compaction report.

There shall be six cores per lot.

Relative Compaction is the percentage ratio of the insitu density of the compacted asphalt and the reference density of the asphalt. The reference density shall be the mean of the maximum density measurements determined from the conformance sampling and testing.

The Characteristic Value of Relative Compaction (Rc) is calculated as follows:

$$R_c = R - ks$$

where R = the mean of the relative compaction results for the lot
k = the standard deviation.

The Standard Deviation (s) is calculated as follows:

$$s = \frac{\sum (x_i - R)^2}{(n - 1)}^{0.5}$$

where xi = an individual test result
R = the mean of n results
n = the number of test results in the lot.

The multiplier values are specified in the MISCELLANEOUS PROVISIONS Section, Multiplier Values clause.

The work represented by a lot shall be assessed as the characteristic value of insitu air voids where the characteristic value of air voids (%) = 100 – Rc.

Conform to the following limits of characteristic Value of Air Voids:

	Light traffic	Medium traffic	Heavy traffic
Conformance	3.0 – 8.0	3.0 – 8.0	3.0 – 7.0

This CONFORMANCE OF COMPACTION sub-clause only applies to a specified asphalt thickness of 30mm or greater.

Backfill all core holes with asphalt conforming to the specified properties for the subject mix, and compact to the required density.

53.26.5.1.3 RIDEABILITY

Surface roughness testing will be carried out by the Engineer at the discretion of the Engineer.

53.26.6 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer. To be acceptable, pavement finish surface shall be smooth, dense and true to shape. The transitions between the treated area and the adjacent undisturbed pavement surface shall be smooth and level. Any loose material must be removed and the site left in a clean condition.

The Contractor shall re-treat any failed areas at his expense.



53.26.6.1 Tolerances

Thickness:	Not less than specified.
Surface levels:	0 to + 10 mm maximum deviation from design level.
Straight edge deviation:	5 mm maximum in 3 metres.
Surface roughness:	50 counts 5mm maximum in 3 metres./km – maximum, or at Engineer’s discretion.
Skid resistance:	Not less than specified in NTTM 304.1, Table 2.
Job mix:	Within the following variation limits.

AS SIEVE (mm)	% PASSING (by mass)
4.75 or larger	+ or – 7
2.36	+ or – 5
1.18 to 0.30.150	+ or – 4
0.15	+ or – 3
0.075	+ or – 2

Bitumen content Maximum variation: 0.3% by mass.

53.26.7 MEASUREMENT AND PAYMENT

The unit of measurement for “Asphalt Surface Maintenance” shall be the plan area, in square metres. The Contractor shall not be paid for any works constructed in excess of the agreed extent.

Payment shall be made at the billed rate for “Asphalt Surface Maintenance” and shall include all work necessary to prepare the maintenance area(s), supply, place, compact and conformance test asphalt pavement to maintenance area(s), to existing pavement.

The Contractor shall be responsible for all costs associated with the supply, delivery and construction of patch materials including any royalty payments for materials extracted from approved quarries.

53.26.8 WARRANTY

The warranty period for this Work shall be 180 days.



53.27 SEALED PAVEMENT SPRAY SEALING FOR MAINTENANCE

53.27.1 GENERAL

This section specifies the requirement for bituminous spray seal work associated with routine maintenance activities. This section is not applicable for major sealing works.

53.27.2 STANDARDS

Conform to the following Standards unless specified otherwise:

PNGS 1185	Methods for Sampling and Testing Aggregate.
AS 1160	Bitumen Emulsions for Construction and Maintenance of Pavements.
PNGS 1373	Residual Bitumen for Pavements.
PNGS 1374	Cut Back Bitumen.
AS NZS 2341	Methods of Testing Bitumen and Related Roadmaking Products.
AS 2758.2	Aggregates and Rock for Engineering Purposes - Aggregate for Sprayed Bituminous Surfacing.
AS 2809.5	Road Tank Vehicles for Dangerous Goods - Tankers for bitumen based products.
AS 3568	Oils for Reducing the Viscosity of Residual Bitumen for Pavements.
AUSTROADS	Bitumen Sprayers.
AUSTROADS	Bituminous Surfacing Sprayed Work January 1989 incorporating Amendments July 1990.
NTTM	Northern Territory Materials Testing Manual.

53.27.3 EQUIPMENT AND PERSONNEL

The sprayer to be currently calibrated with a copy of the calibration certificate on the vehicle.

Sprayer calibration to be to Northern Territory Test Method 500.1. A current calibration certificate issued by a NISIT certified organization will be accepted as an alternative.

Ensure sprayer driver and operator are skilled and trained with an understanding of sprayer calibration and an appreciation of the requirements of the work.

Ensure relevant personnel understand the types and quantities of the various materials and mixtures to be used.

Ensure all relevant personnel are knowledgeable of and understand the safety requirements and procedures, for spray sealing work, specified in the Contractor's Safety Programme.

53.27.4 MATERIALS

The Contractor shall either pick up the required materials from a source designated by the Engineer or supply the materials in accordance with the following requirements

When the Contractor supplies the aggregates, the location of the source must be suitable to both the Department and the Contractor and will be agreed upon prior to the commencement of the Work.

53.27.4.1 Aggregates

Aggregates shall be clean, hard, durable, skid resistant, dry crushed stone, or gravel of uniform quality free from noxious weeds and other deleterious material, and conform with the properties specified.

Nominate source of aggregate supply.

Conform to the table - AGGREGATE GRADING AND AVERAGE LEAST DIMENSION, and to the table - AGGREGATE PROPERTIES



53.27.4.1.1 TABLE - AGGREGATE GRADING AND AVERAGE LEAST DIMENSION

Sieve Size (mm)	% PASSING (DRY MASS)					
	Nominal Size of Aggregate					
	20 mm	16 mm	14 mm	10 mm	7 mm	5 mm
26.5	100					
19.0	85 - 100	100				
16.0	-	80 - 100	100			
13.2	0 - 15	0 - 20	85 - 100	100		
9.5	0 - 5	0 - 2	0 - 15	85 - 100	100	
6.7	0 - 2		0 - 5	0 - 15	85 - 100	100
4.75			0 - 2	0 - 5	0 - 15	85 - 100
2.36				0 - 2	0 - 5	0 - 15
1.18					0 - 2	0 - 5
Minimum ALD(mm) to PNGS 1185.20.1, 20.2 (Direct Measurement)	12.0	9.5	8.0	5.5	3.5	2.5

Only use 20 mm sealing aggregate if the following conditions apply:

- a) Traffic volume exceeds 6,000 vpd (two lanes);
- b) There is a high percentage of heavy traffic;
- c) Class A base used (little likelihood of stone penetration);
- d) Non-residential road.

53.27.4.1.2 TABLE - AGGREGATE PROPERTIES

	TRAFFIC COUNT (AADT: TWO LANES)		
	LESS THAN 300 VPD	300 TO 6,000 VPD	MORE THAN 6,000 VPD
PNGS 1185.15 Flakiness Index	35 maximum	30 maximum	25 maximum
PNGS 1185.23 Los Angeles Abrasion (LAA):			
- Fine Grained Aggregate	30% maximum	25% maximum	20% maximum
- Coarse Grained Aggregate	40% maximum	35% maximum	30% maximum
PNGS 1185.14 Misshapen Particles: Calliper Ratio 2:1	25% maximum	15% maximum	12% maximum
PNGS 1185.24 Sulphate Soundness	15% maximum	12% maximum	10% maximum
PNGS 1185.40/41 Polished Aggregate Friction Value	40 minimum	40 minimum	45 minimum

PNGS 1185.18: Crushed particles in coarse aggregate derived from gravel. Ensure 80% minimum by mass are classified as crushed particles.

PNGS 1185.25.1 Degradation factor – Source rock (Washington Degradation Test). Igneous rocks shall have a minimum value of 50.



- PNGS 1185.26 Secondary minerals content in igneous rocks shall not exceed 25%.
- PNGS 1185.29 Accelerated soundness index by reflux. Igneous rocks shall have a minimum value of 94.
- PNGS 1185.50 Resistance to stripping of cover aggregates from binders. The maximum stripping value of precoated aggregate (precoat shall contain 1% adhesion agent.) shall be 10%.

53.27.4.2 Bitumen

Bitumen utilised for binder to be Class 170 or Class 320.

The Contractor shall submit to the Engineer, the manufacturer's certificate of compliance with all relevant PNG, Australian or other approved Standards for the material supplied.

When required by the Engineer, take samples from the point of delivery.

53.27.4.3 Cutter and Flux

Cutter to be Kerosene.

Flux to be Distillate.

53.27.4.3 Cut Back Bitumen/Prime

Designation is by AMC class.

The Contractor shall submit to the Engineer, the manufacturer's certificate of compliance with all relevant PNG, Australian or other approved Standards for the material supplied.

When required by the Engineer, take samples from the point of delivery.

Conform to the table CUT BACK BITUMEN PROPERTIES.

53.27.4.3.1 TABLE - CUT BACK BITUMEN PROPERTIES

CLASS	VISCOSITY (DYNAMIC) AT 60OC PA.S	APPROXIMATE PARTS BITUMEN TO CUTTER	SPRAYING TEMPERATURE OC
Light			
AMC 00	0.008 - 0.016	100 - 100	Ambient
AMC 0	0.025 - 0.05	100 - 80	35 - 55
AMC 1	0.06 - 0.12	100 - 50	60 - 80
Medium			
AMC 2	0.22 - 0.44	100 - 40	75 - 100
AMC 3	0.55 - 1.10	100 - 30	95 - 115
AMC 4	2.0 - 4.0	100 - 20	110 - 135
Heavy			
AMC 5	5.5 - 11.0	100 - 12	120 - 150
AMC 6	13.0 - 26.0	100 - 7	135 - 160
AMC 7	43.0 - 86.0	100 - 3	150 - 175

53.27.4.4 Precoat and Adhesion Agents

Advise precoat/adhesion agent details with the Engineer.

The Contractor shall submit to the Engineer, the manufacturer's certificate of compliance with all relevant PNG, Australian or other approved Standards for the material supplied.

When required by the Engineer, take samples from the point of delivery.

Precoat to conform to the following:

Adhesion agent (by volume): minimum 1% precoat.

Bitumen residue (by mass): minimum 25% precoat.



Viscosity (Dynamic) at 60°C: 0.003 to 0.020 Pa.s.

53.27.4.5 Bitumen Emulsion

Manufactured from Class 170 or Class 320 Bitumen.

The Contractor shall submit to the Engineer, the manufacturer's certificate of compliance with all relevant PNG, Australian or other approved Standards for the material supplied.

When required by the Engineer, take samples from the point of delivery.

Grade of emulsion to be designated by the Engineer.

AM	-	aggregate mixing
RS	-	rapid setting
SS	-	slow setting
A	-	anionic
C	-	cationic.

Utilize within 90 days of manufacture.

Spraying temperature: 60% bitumen content 30 to 50°C.

53.27.4.6 Polymer Modified Binder

A mixture of Class 170 or Class 320 bitumen and polymer additive.

The Contractor shall submit to the Engineer, the manufacturer's certificate of compliance with all relevant PNG, Australian or other approved Standards for the material supplied.

When required by the Engineer, take samples from the point of delivery.

Conform to the table POLYMER MODIFIED BINDERS.



53.27.4.6.1 TABLE - POLYMER MODIFIED BINDERS (PMBS) FOR SPRAYED SEALING APPLICATIONS

Comply with the following minimum requirements:

Test Method	Minimum Test Frequency	CLASS	S10E	S15E	S20E	S25E	S30E	S35E	S40R	S45R	S50R	S55R	S60R
PERFORMANCE RELATED PROPERTIES													
DRT-MAT-TP676	1 per 10,000 L	Consistency at 60°C (Pa.s) min.	NA(2)	1000	2000	4500	6000	NA	NA	1800	2600	4000	5000
DRT-MAT-TP676	1 per 10,000 L	Consistency at 45°C (Pa.s) min.	2000	NA	NA	NA	NA	3000	4000	NA	NA	NA	NA
DRT-MAT-TP676	1 per 10,000 L	Stiffness at 15°C (kPa) max. (3)	100	100	100	100	100	100	180	180	180	140	140
MBT25	1 per 3 months	Aggregate retention (%) min. (3)	65 @ 125J	65 @ 125J	65 @ 225J	65 @ 125J	65 @ 17.5J	65 @ 225J	65 @ 125J	65 @ 225J	65 @ 225J	65 @ 125J	65 @ 17.5J
MBT32	1 per 3 months	Compression limit at 70°C, 2 kg (mm) min.	NA	NA	NA	NA	NA	NA	0.2	0.2	0.2	0.2	0.2
INDEX PROPERTIES													
DRT-MAT-TP676	1 per 10,000 L	Elastic Recovery at 60°C, 100 s (%) min.	NA	60	70	85	90	NA	NA	25	35	35	-
DRT-MAT-TP676	1 per 10,000 L	Elastic Recovery at 45°C, 100 s (%)	15-30	NA	NA	NA	NA	10-25	10 min.	NA	NA	NA	NA
DRT-MAT-TP676	1 per 10,000 L	Elastic Recovery at 15°C, 100 s (%) min. (3)	35	55	70	80	85	25	NA	30	40	50	60
MBT23	1 per 100,000 L	Toughness at 4°C, 1 m (Nm) min. (3, 5)	6	8	8	8	8	8	-	6	6	8	8



53.27.4.6.1 TABLE POLYMER MODIFIED BINDERS (PMBS) FOR SPRAYED SEALING APPLICATIONS (CONT'D)

Comply with the following minimum requirements:

Test Method	Minimum Test Frequency	CLASS	S10E	S15E	S20E	S25E	S30E	S35E	S40R	S45R	S50R	S55R	S60R
HANDLING PROPERTIES													
MBT09	1 per 100,000 L	Ease of remixing (%) max. (3)	8	8	8	8	8	8	8	8	8	8	8
DRT-MAT-TP677	1 per 10,000 L	Viscosity at 165°C (Pa.s) max. (6)	0.8	0.8	0.8	0.8	0.8	0.8	4.5	4.5	4.5	4.5	4.5
AS 2341.14	1 per 100,000 L	Flash Point (°C) min.	250	250	250	250	250	250	250	250	250	250	250
MBT03	1 per 100,000 L	Loss on heating (% mass) max.	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
PRODUCTION CONTROL PROPERTIES (7)													
DRT-MAT-TP675	1 per 10,000 L	Torsional Recovery at 25°C, 30 s (%) min.	15	35	48	55	70	15	5	25	25	30	50
AS 2341.18	1 per 10,000 L	Softening point (°C) min.	50	60	70	75	77	50	50	55	55	62	72

NOTE 1: Class of PMB: S = Sealing Grade.
E = Elastomeric Polymer.
R = Granulated Crumbed Rubber.

NOTE 2: NA = Not applicable for that PMB class.

NOTE 3: MBT methods are APRG test methods.

NOTE 4: DRT-MAT test methods are from Department of Road Transport, South Australia.



53.27.5 PROCEDURES

53.27.5.1 Preparation Of Pavement

Sweep the pavement surface to remove loose stones, dust, dirt and foreign matter immediately before spraying.

Maintain the prepared surface.

Extend sweeping clear of the area to be sealed.

Remove adherent patches of foreign material with a steel scraper.

Dampen the prepared surface lightly, immediately before spraying.

Remove water from the surface of primed or sealed pavements before applying binder.

Do not allow traffic on the prepared surface.

53.27.5.2 Setting Out

Mark out by string line or paint.

Include pavement widening.

53.27.5.3 Prime and Primer Seals

Cut-back bitumen mixed on site.

Heat bitumen to a temperature appropriate for achieving final spraying temperature making allowance for incorporation of the unheated cutter.

Add unheated cutter to heated bitumen and circulate until a homogeneous mixture is achieved.

Spray immediately circulation is complete.

Allow at least three days to elapse after priming before applying the binder coat.

Keep traffic off the primed surface for this period.

Use a primer seal if traffic cannot be kept off treated surface for three days.

53.27.5.4 Supply Of Aggregate

Provide a separate site for each aggregate size. Allow 15 metres between adjacent sites.

Ensure sites are well drained and on hard ground. Avoid contamination by dust.

Maintain access roads and stockpile sites.

Avoid sites under trees, telephone lines, overhead transmission lines or where overhead clearance is less than 6 metres.

Clear all vegetation to 5 m beyond stockpile boundary.

Construct gravel foundation for stockpiles with 100 mm compacted thickness. Trim and compact to 95% relative compaction.

Remove from site any non-conforming aggregate.

Construct stockpiles at least 1 metre high and batter sides 1 vertical to 1.5 horizontal.

Trim neatly to facilitate measurement.

53.27.5.5 Precoating Aggregate

Apply a uniform film of precoating material to the aggregate.

Aggregate which has been excessively precoated will be rejected.

Respray aggregate which has been insufficiently precoated to achieve the rate indicated in 53.27.4.4.



53.27.5.6 Adhesion Agent

Mix at rates indicated in the procedure into precoat and binder.

Circulate in binder for 20 minutes before spraying.

53.27.5.7 Seal Coats

53.27.4.8.1 STRAIGHT RUN BINDER

Store/hold at temperature below spraying minimum.

Heat to spraying temperature but do not exceed maximum.

Avoid heating bitumen in quantities excess to requirement, and do not hold beyond four hours at spraying temperature.

Heat bitumen to within range 150 to 180 degrees C for straight run bitumen.

Prevent foaming.

53.27.5.7.2 POLYMER MODIFIED BINDERS

Provide test results from a NISIT registered testing facility, or manufacturer's certification, of the properties of the binder modified with the nominated type and quantity of polymer.

Store, mix, heat and spray the polymer modified binder as recommended by the polymer manufacturer.

Use 1% adhesion agent or alternative quantity as recommended by the polymer manufacturer.

Both coats of two coat seals shall contain polymer.

53.27.5.8 Spraying - Notice

Notice - Give the Superintendent 48 hours notice of intention to spray bitumen.

Store/hold binders at temperature below spraying minimum.

Heat to spraying temperature but do not exceed maximum.

Avoid heating binders in quantities excess to requirement, and do not hold beyond two hours at spraying temperature.

Bitumen to be removed from the site where

Stored or held beyond 48 hours at temperature exceeding 120 deg. C; and

heated to above 190 deg. C for straight run bitumen or above the maximum recommended temperatures specified by the polymer manufacturer.

53.27.5.8.1 ATMOSPHERIC CONDITIONS

Commence spraying only when pavement temperature

- is in excess of 20 deg. C
- or
- has been in excess of 15 deg. C for at least one hour.

Cease spraying if rain threatens, or in windy or dusty conditions.

Protect the work in the event of a sudden change in weather by closing the affected section of road or by rigidly controlling traffic speed.

53.27.5.8.2 PREPARING THE SPRAYER

Ensure the sprayer has a current calibration certificate.

Circulate the mixture.



Check the horizontal and vertical alignment and the cleanliness of the spraybar and its extensions.

Determine the appropriate number of nozzles for the width to be sprayed. Ensure the end nozzles fitted are the correct type.

Check that the nozzles in use are symmetrical about the sprayer.

Check the alignment and setting of the nozzle to ensure that the fans of material from intermediate nozzles are parallel and at an angle of 30 deg. to the centre line of the spraybar. Ensure that the fans from the end nozzles are parallel to each other and at an angle of 45 deg. to the centre line of the spraybar.

Set the height of the spraybar so that the lower faces of the nozzles are 250 mm (or that specified on the calibration certificate) above the pavement when the sprayer is full.

Fit an end shield to the spraybar when necessary to prevent spraying material on the kerb, or to counter any wind effects which would compromise uniform spraying.

Position the guide rod to conform to the setting out and edges of spray. Check by making a dummy run.

53.27.5.8.3 APPLICATION SPRAY RATES – APPROVAL

Application spray rates shall be determined by the Contract.

Supply the following test results to the Superintendent, prior to the planned commencement of sealing.

For new seals, supply the ALD of the aggregate to be used.

For reseals, supply the ALD of the aggregate to be used and the existing surface texture depth.

Approval – Do not commence spraying until the Superintendent is advised of the application spray rates by the Contractor.

53.27.5.8.4 PREPARATION FOR SPRAYER RUN

Record the volume and temperature of the sprayer contents while it is on level ground.

Determine the length of sprayer run from the available quantity in the sprayer and the application rate. Ensure the area to be sprayed is not greater than the area that can be covered by aggregate in the loaded trucks.

Start and finish each spray run on a protective strip of paper placed on the pavement. The paper to be wide enough to ensure the sprayed material is being discharged correctly over the full width of spray. Place sufficient protective paper to protect road fixtures.

Place paper on the pavement as masking around areas to be sprayed or wherever the sprayer is stationary on the road pavement.

53.27.5.8.5 SPRAYER RUN

Attain uniform spraying speed before spraying commences.

Avoid an excess or deficiency of material due to faulty overlap at longitudinal joints when spraying a road in half-widths.

Overlap to be 300 mm with an intermediate nozzle.

End nozzles are not to be used on an overlap.

Cease spraying before the level of material in the tank falls to a level which reduces the full discharge of the pump.

Remove and dispose of all paper.

Clean off any sprayed material from road fixtures.

53.27.5.8.6 HAND SPRAYING

Plan work to minimise the requirement for the use of a hand sprayer.



Any strips of pavement not adequately covered with sprayed material to be sprayed later with the hand attachment.

53.27.5.9 Application Of Aggregate

Load aggregate into tip trucks using an approved aggregate loader which removes dust, dirt and oversize stone while applying precoat.

Apply aggregate to sprayed binder within:

- 10 minutes where the pavement temperature is 20 deg. C or greater.
- 5 minutes where the pavement temperature is between 15 and 20 deg. C.

Polymer Modified Binders: Apply aggregate within 5 minutes irrespective of pavement temperature.

Apply aggregate to emulsion coat before the emulsion breaks.

Spread the aggregate evenly and uniformly over the sprayed surface.

Use a mechanical spreader.

Rerun or hand cover bare or insufficiently covered places after the first spreading.

53.27.5.9.1 ROLLING RATE

Roll the treated surface with self-propelled rubber tyred rollers with a minimum tyre pressure of 600 kPa and a minimum wheel load of 1 tonne.

After initial slow pass the roller speed shall be between 10 and 25 km/h.

Conform to the following:

- Entire area to receive one roller pass immediately after covering.
- 25% of rolling within 2 hours of covering.
- 50% of rolling within 6 hours of covering.
- 100% of rolling within 12 hours of covering.

Minimum Rolling Rate: 1 roller hour per 2,000 litres of binder.

For two coat treatments when the second coat is to be applied immediately, the total rolling on the first coat shall be double that specified.

Roll in daylight hours only. Sweep the surface after rolling. Ensure a uniform distribution of aggregate.

Adjust drag broom to distribute surplus aggregate, but not to dislodge embedded aggregate. Ensure aggregate on the final surface is uniformly distributed, and firmly held by binder.

Reroll the surface after sweeping to ensure uniform bedding of aggregate in binder.

53.27.5.10 Traffic

Prohibit traffic

- from new work until at least 25% of rolling has taken place; and
- from adjacent strip of roadway during spraying.

Sweep all loose aggregate from the carriageway.

53.27.5.11 Waste Material

Remove from the site and dispose of all waste material.



53.27.6 ACCEPTANCE CRITERIA

53.27.6.1 General

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer.

Bitumen application rates for seal coats are to achieve a uniform height of two thirds of the average least dimension after placement and rolling of aggregate.

Aggregate spread rates are to achieve a uniform rate of 800 / ALD in square metres per cubic metre.

53.27.6.2 Tolerances

Final surfaces shall conform to the following:

Skid Resistance (by NTTM 304.1): Not less than that specified in NTTM 304.1, Table 2.

Skid resistance testing may be carried out by the Engineer as directed by the Engineer.

Non-conforming skid resistance will be rejected. Rectify non-conforming work by methods approved by the Engineer, at the Contractor's expense, including the cost of testing.

Remove from the site, binder which has been overheated or has deteriorated or become contaminated prior to its application to the road.

53.27.7 MEASUREMENT AND PAYMENT

53.27.7.1 Primer Seal

Measured in square metres for the size nominated.

Payment shall be for preparation, precoat, binder and aggregate and all activities to achieve the final sealed surface.

53.27.7.2 Reseal work

Measured in square metres for the size nominated and binder type nominated.

Payment shall be for preparation, precoat, binder and aggregate and all activities to achieve the final sealed surface.

Make allowance for existing texture.

53.27.8 WARRANTY

Warranty period for this Work shall be twelve (12) months.



53.28 SEALED PAVEMENT EDGE BREAK REPAIR

53.28.1 GENERAL

The Work consists of the repair of edge break in flexible pavements.

Edge Break is defined as fretting or breaking of the edge of a bituminous surface, such that seal loss encroaches into the carriageway by more than 100 mm from the nominal seal edge or onto the white edge line.

53.28.2 STANDARDS

Conform to the following Standards and Publications unless specified otherwise:

PNGS 1185	Methods for Sampling and Testing Aggregate.
AS 1160	Bitumen Emulsion for Construction and Maintenance of Pavements.
AS 1348.1	Road and Traffic Engineering: Part 1 Road Design and Construction.
PNGS 1373	1990 Residual Bitumen for Pavements.
AS 2150	Hot mix Asphalt.
PNGS 1374	Cut Back Bitumen.
AS 2357	Mineral Fillers for Asphalt.
AS 2758.5	Aggregates and Rock for Engineering Purposes: Asphalt Aggregates.
AS 2891	Methods of Sampling and Testing Asphalt.
AS 4283	Cold Mix Asphalt for Maintenance Patching
AUSTROADS	A Guide to the Visual Assessment of Pavement Conditions
AUSTROADS	AP-G66/02: Asphalt Guide
NAASRA	Bituminous Surfacing Volume 2 Asphalt Work 1984.

53.28.3 MATERIALS

The Contractor shall supply pothole patch material, or commercially produced proprietary patching material, satisfactory to the Engineer. Preparation and application of approved proprietary patching materials shall closely follow manufacturer's instructions.

53.28.3.1 Aggregates

The combined particle size distribution to be in accordance with the tables MIX PROPORTIONS.

53.22.3.1.1 COARSE AGGREGATES

Ensure that coarse aggregates are clean, hard, high strength, angular, skid resistant, durable crushed stone of uniform quality and free from laminated particles, clay and other aggregations of fine material, soil, organic matter and any other deleterious material. Conform to the following:

Proportion of misshapen particles: 15% maximum at 2:1 caliper ratio.

Los Angeles Abrasion

- Fine grained aggregate: 30% maximum loss.
- Coarse grained aggregate: 35% maximum loss.



Sulphate Soundness: 12% maximum loss.

Polished Aggregate Friction Value: 45 minimum.

53.22.3.1.2 FINE AGGREGATES

Ensure that fine aggregates are clean, hard, sharp, washed, durable natural sand and/or material manufactured from crushed stone of uniform quality and free from clay and other aggregations of fine material, soil, organic matter and any other deleterious material.

53.28.3.2 Mineral Filler

A finely divided mineral material, hydrated lime or cement with a particle size smaller than 0.075 mm.

Use filler that is dry, free from lumps, clay, organic material or any other deleterious material, and complies in all other respects with the requirements of AS 2357.

53.28.3.3 Bituminous Binder

A straight run bitumen Class 170 or Class 320, as specified by the contract

53.28.3.4 Bitumen Emulsion

A rapid setting bitumen emulsion made with bitumen Class 320

53.28.3.5 Additive

An additive may be proposed provided that full details of the type of additive are provided and the mix design standards of the PROPORTIONING OF MIXES Clause are attained.

53.28.3.6 Proportioning Of Mixes For Hot Mix Asphalt

53.28.3.6.1 MIX TYPE FOR HOT MIX ASPHALT

The Contract will specify Rural and/or Urban Mix Type Number to be applied.

53.28.3.6.2 MANUFACTURE OF HOT MIX ASPHALT

Mix in a plant capable of producing asphalt that complies with the approved design mix.

Bitumen temperature: 135 deg. C to 160 deg. C prior to mixing.

Heat aggregates to such a temperature that when filler and binder are added, the temperature of the mixed asphalt is between 135 deg. C and 170 deg. C.

53.28.3.6.3 MIX ASSESSMENT AND APPROVAL OF HOT MIX ASPHALT TYPES

Upon request by the Engineer, provide a minimum of 3 Marshall Test results of a job mix and submit to the Engineer the following:

- A statement detailing the combined aggregate/filler grading and binder content of the design mix, and the proportion of each constituent material in the design mix.
- Samples of the constituent materials in the design mix, and
- Details of the type of additive/s if any, and its proportion within the mix.

Upon request by the Engineer, provide sample quantities as listed in the Table - CONSTITUENT MATERIAL SAMPLE QUANTITIES FOR HOT MIX ASPHALT.



53.28.3.6.4 CONSTITUENT MATERIAL SAMPLE QUANTITIES FOR HOT MIX ASPHALT

Material	Sample Quantity
Binder	15 litres
Coarse Aggregate	
- Each constituent material nominal size $\geq 10\text{mm}$	100 kg
- Each constituent material nominal size $< 10\text{mm}$	75 kg
Fine Aggregate - each constituent material	50 kg
Added Filler	5 kg
Additive	As requested - sufficient for job mix verification

At the discretion of the Engineer, the submitted samples will be dispatched to an appropriate asphalt testing laboratory for Level 1 and Level 3 testing, as per the procedures of AP-G66/02 (Asphalt Guide).

Using the samples of constituent materials submitted, the proposed design mix may be assessed for compliance with the requirements of Clause: PROPERTIES and TABLE – MIX PROPORTIONS. The proposed job mix shall have a maximum Wheel Tracking Rate of 0.35mm per 1,000 passes at design air voids for urban work, and 0.45mm per 1,000 passes at design air voids for rural work, as determined by the Wheel Tracking test defined in AP-G66/02 (Asphalt Guide). The Wheel Tracking Rate is the slope of the rut depth versus number of passes curve between 4,000 and 10,000 passes. Adjust the proposed mix design as required to satisfy the specified requirements.

The Combined aggregate/filler grading of the approved job mix will be termed the Approved Job Grading. The binder content of the approved job mix will be termed the Approved Job Binder Content.

Failure of submitted samples of constituent materials or the job mix to comply with the requirements specified herein will result in rejection of the job mix. In this case, submit a revised job mix design.

53.28.3.6.5 PROPERTIES OF HOT MIX ASPHALT

Conform to the following mix requirements:

MARSHALL CHARACTERISTICS	RURAL	URBAN
Compactive effort (number of blows each end of specimen):	50	75
Stability of mix (kN):	5 minimum	8 minimum
Flow (mm):	2 – 5	2 – 5
Air voids (%):	3 – 7	3 – 7
Voids in mineral aggregate (%):	14 minimum	14 minimum

Conform to the following target mix proportions and properties;



53.28.3.6.6 TABLE - MIX PROPORTIONS

Mix Type	HM 1	HM 2	HM 3	HM 4	HM 5	HM 6
	DENSE GRADED			OPEN GRADED		
	% PASSING (DRY MASS)					
AS SIEVE (mm)	5 mm	10 mm	14 mm	20 mm	10 mm	20 mm
53.0						
37.5						
26.5				100		100
19.0			100	95 – 100		95 - 100
13.2		100	85 – 100	75 – 90	100	80 - 90
9.5		90 - 100	70 – 85	60 – 80	90 - 100	65 - 80
6.7	100	70 - 90	62 – 75	50 – 70	40 - 70	52 - 65
4.75	85 - 100	58 - 76	53 – 70	40 – 60	30 - 50	45 - 55
2.36	55 - 75	40 - 58	35 – 52	25 – 43	10 - 30	30 - 43
1.18	38 - 57	27 - 44	24 – 40	18 – 35	5 - 20	20 - 35
0.60	26 - 43	17 - 35	15 – 30	14 – 27	0 - 15	14 - 27
0.30	15 - 28	11 - 24	10 – 24	9 – 21	0 - 10	9 - 21
0.15	8 - 18	7 - 16	7 – 16	6 – 15	0 - 7	7 - 15
0.075	4 - 11	4 - 7	4 – 7	3 – 7	0 - 4	3 - 6
Bitumen binder (% by mass)	5.0 - 7.0	4.5 - 6.5	4.6 - 6.5	4.0 – 6.0	3.5 – 5.5	3.5 - 5.5
Compacted thickness (mm)	10 - 25	25 - 40	35 – 55	50 – 80	25 - 40	50 - 80
Bitumen film thickness (min micron)	8.5	8.5	8.5	8.5	8.5	8.5

The grading curve shall be smooth and shall not vary from the outer one third of the range between the specified limits for one sieve size to the opposite outer one third of the range between the specified limits for an adjacent sieve size.

53.28.3.7 Proportioning Of Mixes For Cold Mix Asphalt

53.28.3.7.1 MIX TYPE FOR COLD MIX ASPHALT

The Contract will specify the Mix Type Number to be applied.

53.28.3.7.2 MANUFACTURE OF COLD MIX ASPHALT

Dry mix aggregate and mineral filler to provide a homogenous blend.

Add bituminous binder until the specified percentage is reached.

Carry out further mixing until a minimum of 90% of the coarse aggregate particles are coated.

Add additional bitumen so that a satisfactory mix can be achieved, if so directed by the Superintendent.

Conform to the following mix proportions;



53.28.3.7.3 TABLE – AGGREGATE AND MINERAL FILLER MIX PROPORTIONS

Mix Type	CM 1	CM 2	CM 3	CM 4	CM 5	CM 6	CM 7	CM 8
	DENSE GRADED				OPEN GRADED			
	% PASSING (DRY MASS)							
AS SIEVE (mm)	7 mm	10 mm	14 mm	20 mm	7 mm	10 mm	14 mm	20 mm
53.0								
37.5								
26.5				100				100
19.0			100	95 – 100			100	95 – 100
13.2		100	85 – 100			100	90 – 100	50 – 90
9.5	100	90 – 100	70 – 85	58 – 74	100	90 – 100	40 – 75	30 – 65
6.7	90 – 100			45 – 60	85 – 100	30 – 75	10 – 35	10 – 35
4.75	70 – 90	58 – 70	46 – 65	37 – 50	30 – 70	20 – 55	5 – 25	5 – 25
2.36	45 – 60	35 – 50	28 – 45	22 – 36	10 – 40	5 – 30	0 – 10	0 – 10
1.18		22 – 38	15 – 30	12 – 26	0 – 20	0 – 10		
0.60	15 – 30	12 – 27	10 – 23	6 – 20	0 – 10			
0.30	10 – 20	6 – 16	5 – 17	4 – 15				
0.15	4 – 14	4 – 14	3 – 11	2 – 10				
0.075	3 – 8	2 – 6	2 – 5	1 – 5	0 – 4	0 – 4	0 – 4	0 – 4
Total %	100	100	100	100	100	100	100	100

The grading curve shall be smooth and shall not vary from the outer one third of the range between the specified limits for one sieve size to the opposite outer one third of the range between the specified limits for an adjacent sieve size.

53.28.3.7.4 TABLE – TOTAL MIX PROPORTIONS OF COLD MIX ASPHALT

Mix Type	CM 1	CM 2	CM 3	CM 4	CM 5	CM 6	CM 7	CM 8
	DENSE GRADED				OPEN GRADED			
SIZE	7 mm	10 mm	14 mm	20 mm	7 mm	10 mm	14 mm	20 mm
Material	% OF TOTAL MIX							
Aggregate and filler %	94.2 – 95.2	94.8 – 95.8	95.0 – 96.0	95.3 – 96.3	95.0 – 96.0	95.5 – 96.5	95.5 – 96.5	96.0 – 97.0
Residual binder %	4.8 - 5.8	4.2 - 5.2	4.0 - 5.0	3.7 - 4.7	4.0 - 5.0	3.5 - 4.5	3.5 - 4.5	3.0 - 4.0
Total Mix %	100	100	100	100	100	100	100	100



53.22.3.7.5 SPECIFICATION LIMITS FOR THE BINDER MIX OF COLD MIX ASPHALT

Bitumen:	100 parts
Flux:	Between 5 and 15 parts, depending on location and climatic conditions. Will be specified by the Engineer
Cutter:	10 parts

53.28.4 PROCEDURES

Prior to the commencement of any pavement works, the Contractor is to confirm and agree with the Engineer, the Edge Break size and the extent of repairs.

53.28.4.1 Shoulder Preparation

In areas of edge break repair, there may be a need to prepare the shoulder before repair of the edge break can start. Repairs to these conditions shall comply with the requirements of Specification 53.29 "Maintenance of Unsealed Shoulders".

53.28.4.2 Preparation of Edge Break Repair Area

Before edge break is repaired, firm support shall be provided on each side of the repair area including tapers, to the depth specified in the schedule supplied by the Engineer. A firm foundation and a vertical face of not less than 25 mm where the edge break fill material abuts the existing seal, are required.

53.28.4.3 Construction of Edge Break Fill Material

The edge break fill material shall be premix. Hotmix shall be used if specified by the contract.

To ensure bond between existing and fill material including the vertical seal face, a light tack coat of emulsion shall be applied before any fill material is placed.

Upon completion, the outer edge of the repair shall present a uniform line lying between zero and 70 mm outside the nominal edge of the seal being repaired. At the end of the repair proper, any required transition between the existing seal edge and the repair edge shall be effected by a flat taper.

Compact asphalt material with hand tamper for small repairs where possible, compact by using a rammer or vibrating plate.

Compact longer repairs with a vibrating smooth drum roller.

Cold mix patches should be topped with a light application of sand to prevent pick up.

Temporary repairs with aggregate and emulsion requires the approval of the Engineer. For such work, keep traffic off the repair area until material is stable.

53.28.4.4 First Coat Chip Sealing

Where required by the Engineer, sealing of the repair shall be applied so that upon completion, the work has a tidy appearance of rectangular shape without ragged edges. Any taper shall be sealed to follow the tapered line to form a tidy triangular shape.

The edge break repair area plus an overlap of 70 mm ± 20 mm onto the existing seal shall be sealed.

53.28.5 SAMPLING AND TESTING

The Contractor shall retain copies of his supplier's QC testing results, and undertake the quality control testing and inspections as required by the Contractor's QC Program. The Contractor shall make available, all QC test and inspection results when requested by the Engineer. The Contractor shall supply material samples to the Engineer for QA (Audit) testing purposes when requested.



53.28.6 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer. To be acceptable:

- Edge break repairs shall be carried out so that upon completion of the work a stable repair which does not wave or creep under the action of compaction equipment or road traffic is produced. The finished surface shall be a continuation of the adjacent sealed surface and shall not hold surface water.
- The surface shape of repairs shall be such that the existing road cross-fall is maintained, the deviation when measured with a two metre straightedge shall not be greater than 10 mm, both along the repair and between the existing pavement and the repair and there shall be no sharp ridges.
- Patches must provide a dense, smooth and level transition between the treated area and the adjacent undisturbed pavement surface.
- No flushing or bleeding of the completed surfacing.
- That the repair remains an integral part of the pavement structure within the specified tolerance.
- Any loose material must be removed and the site left in a clean condition.

The Contractor shall re-treat any failed areas at his expense.

53.28.7 MEASUREMENT AND PAYMENT

The unit of measurement for “**Edge Break Repair**” shall be the linear distance, in metres, to the extent as agreed to under Sub-Clause 53.28.4. The Contractor shall not be paid for any works constructed in excess of the agreed extent.

Payment shall be made at the billed rate for “**Edge Break Repair**” and shall include all work necessary to prepare the repair area(s), supply, place and compact patch material to patch areas, to existing road levels.

Where chip sealing of the edge break is required, payment will be made at the billed rate for each metre of edge break sealed.

The Contractor shall be responsible for all costs associated with the supply, delivery and construction of patch materials including any royalty payments for materials extracted from approved quarries.

53.28.8 WARRANTY

The warranty period for this Work shall be 90 days.



53.29 MAINTENANCE OF UNSEALED SHOULDERS

53.29.1 GENERAL

The Work consists of the activities for the maintenance of unsealed road shoulders, both gravel and grassed, including feathered edges, tapers and surface water channels where the adjacent pavement is sealed.

The scope of this specification does not include mowing of grassed shoulders or chemical spraying.

53.29.2 STANDARDS

Conform to the following Standards and Publications unless specified otherwise:

PNGS 1185 Methods for Sampling and Testing Aggregate.

AS 1289 Method of Testing Soils for Engineering Purposes.

AS 1348.1 Road and Traffic Engineering: Part 1 Road Design and Construction.

53.29.3 MATERIALS

The Contractor shall either pick up crushed gravel or soil material from a source designated by the Engineer or supply shoulder materials in accordance with the following requirements.

When the Contractor supplies crushed gravel or soil, the location of the source must be suitable to both the Department and the Contractor and will be agreed upon prior to the commencement of the Work.

53.43.3.1 Gravel

Obtain material from sources of naturally occurring deposits.

Produce required properties by crushing, screening, mixing or other processes necessary.

Ensure particles are tough, durable and of a tightly binding nature free of organic or other deleterious matter.

Conform to the tables GRAVEL PARTICLE SIZES and GRAVEL PROPERTIES.

53.43.3.1.1 TABLE - GRAVEL PARTICLE SIZES

AS SIEVE (mm)	PERCENTAGE PASSING	
	2	3
75.0		
37.5	100	
19.0	70 - 100	100
9.5	50 - 80	70 - 100
4.75	35 - 65	50 - 80
2.36	25 - 50	35 - 65
0.425	10 - 30	15 - 35
0.075	4 - 16	6 - 20

Gradings 2 and 3 are for Base and Shoulder.



53.43.3.1.2 TABLE - GRAVEL PROPERTIES

		UNSEALED BASE AND SHOULDER MATERIAL		
1.	Liquid Limit (LL)		35% maximum	
2.	Plasticity Index (PI)		4 - 12%	
3.	Linear Shrinkage (LS)		2 - 8%	
4.	PI x % passing 0.425 mm Sieve		400 maximum	
5.	California Bearing Ratio (CBR) 4 day soaked at 2.5 mm penetration at a relative density of		50 minimum	
			95% MMDD	
6.	Los Angeles Abrasion (LAA) Loss		50 maximum	

53.43.3.2 Sand Clay

A material complying with the following grading and properties:

53.43.3.2.1 TABLE – SAND CLAY GRADING

AS SIEVE (mm)	PERCENTAGE PASSING
4.75	80 - 100
2.36	60 - 100
0.425	30 - 60
0.075	14 - 28

53.43.3.2.2 SAND CLAY PROPERTIES

Plasticity Index: 20 maximum for sealed pavements
15 maximum for unsealed pavements.

Linear Shrinkage: 1% - 8%.

CBR, 4 day soaked at 95% MMDD
at 2.5 mm penetration: 50 minimum.

53.29.4 PROCEDURES

53.29.4.1 Reinstatement or Replacement of Edge Marker Posts, Marker Pegs and Signs

The Contractor shall reinstate, or replace, all removed disturbed or damaged edge marker posts including route position pegs, culvert marker pegs, bridge and hazard markers and signs to their original location at the commencement of the Contract and to the appropriate Transit New Zealand Standards.

The Contractor's failure to reinstate or replace edge marker posts, bridge end and hazard markers and signs as specified, will result in the Engineer arranging for this work to be carried out, with all costs being recovered from payments owing to the Contractor.

53.29.4.2 Maintenance of Unsealed Shoulders, Feather Edges and Tapers

The Contractor shall maintain all gravel and grassed shoulders within the scheduled lengths including feather edges, tapers and unsurfaced water channels and ensure that they are maintained in an even and compacted condition.



The Contractor shall remove all large segregated material from the shoulder and road surface covered by maintenance grading, and shall supply make-up material to maintain the shoulder and avoid drops adjacent to the sealed surface.

Removal of high grass shoulders, improvements to shoulders and surface water channels are not included in this contract. Where ponding of water is due to a high grass shoulder a positive drainage channel shall be provided.

53.29.4.2.1 Widths and Crossfalls

The existing widths and crossfalls of the shoulders, feather edges, tapers and surface water channels shall be maintained.

53.28.4.2.2 Shoulder Maintenance

- (a) All shoulder material used whether aggregate or topsoil, shall conform to the nominated specification in the contract documents or shall be an equivalent material.
- (b) Shoulder material shall be maintained in an even and compacted condition. Depth of loose material shall not exceed 20 mm loose depth.
- (c) Shoulder material shall not encroach onto the sealed pavement at any time except during maintenance operations. Shoulder material shall be maintained level with the edge of the adjacent sealed carriageway at all times with the tolerances specified in clause 6.3 (Edge Rutting).
- (d) For grassed shoulders an even vegetation cover shall be maintained.

53.29.4.2.3 Edge Rutting

Edge rutting shall not be permitted to exceed a cumulative length of 100 m by 30 mm deep per 1 kilometre. Edge rutting is defined as the difference in the level of the top surface of shoulder aggregate or topsoil, and the edge of the adjacent sealed carriageway.

Isolated rutting at any location shall not exceed a depth of 50 mm.

53.29.4.2.4 Ponding of Water

All shoulders shall be maintained so that no water ponds on the sealed carriageway, shoulder or taper edge.

53.29.4.3 Traffic Control

At all times during the work or activities included in this specification, the Contractor shall take responsibility to ensure all traffic control is carried out in accordance with the Department's Specification for Road and Bridge Works and Safety Guidelines.

53.29.5 SAMPLING AND TESTING

The Contractor shall retain copies of his supplier's QC testing results, and undertake the quality control testing and inspections as required by the Contractor's QC Program. The Contractor shall make available, all QC test and inspection results when requested by the Engineer. The Contractor shall supply material samples to the Engineer for QA (Audit) testing purposes when requested.

53.29.6 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer. To be acceptable:

- (a) the shoulders remain compacted, and shed water from the adjacent sealed carriageway without ponding or edge rutting.
- (b) all work is carried out in accordance with this specification.
- (c) the feather edges, tapers and surface water channels retain their widths and crossfalls.



(d) loose material are removed and the site left in a clean condition.

The Contractor shall re-treat any failed areas at his expense.

53.29.7 MEASUREMENT AND PAYMENT

The unit of measurement for “**Maintenance of Unsealed Shoulders**” shall be in kilometres of road with unpaved shoulders maintained, without deduction for sections of lined water channel.

Payment shall be made at the billed kilometre rate of road, for “**Maintenance of Unsealed Shoulders**” on both sides of the road and shall include all work necessary for the maintenance of unsealed road shoulders, both gravel and grassed, including feathered edges, tapers and surface water channels where the adjacent pavement is sealed.

The Contractor shall be responsible for all costs associated with the supply, delivery and construction of materials, including any royalty payments for materials extracted from approved quarries.

53.29.8 WARRANTY

The warranty period for this Work shall be 90 days.



53.41 MAINTENANCE AND PREPARATION OF GRAVEL SURFACED ROADS

53.41.1 GENERAL

The Work consists of using a grader to maintain gravel surface roads, or to prepare gravel roads prior to gravel surfacing and/or dust abatement.

The road preparation work consists of preparation of the roadway and retrieving existing gravel, not rebuilding the roadway. Any major realigning or width changes will be undertaken as a separate activity.

53.41.2 MATERIALS

In normal circumstances, no materials are required for this Work. If gravel is required, it shall be supplied in accordance with **Specification 53.42, "Spot Gravelling"**, or **Specification 53.43, "Gravel Surfacing (Sheeting)"**.

53.41.3 EQUIPMENT

The Contractor shall supply a motor grader in good working condition and meeting the following requirements:

- possesses a 150 horsepower engine or greater;
- is less than 12 years old. For smaller sections of gravelled roads, an older grader may be used if approved by the Engineer;
- is equipped with functioning headlights, tail lights, 4-way flashers, back up alarm, revolving light, slow moving symbol and warning flags on the outward edges of the cab and moldboard;
- is equipped with an adequate set of blades, scarifier teeth, shanks or Sandvik blades and bits (System 2000) or equivalent;

If specified in the contract, the Contractor shall also supply pneumatic wheeled roller(s) and water tanker(s) with spray bar, gravel retriever, steel-wheeled roller and safety warning signs.

The Engineer reserves the right to inspect the equipment prior to commencement of the Work and at any time during the term of the Contract to ensure the equipment meets all requirements. Equipment downgrades will not be accepted unless specifically authorized by the Engineer.

53.41.4 PROCEDURES

53.41.4.1 General

For all work covered by this specification, graders shall travel in the same direction as the traffic at all times.

Material used or resulting from the performance of this work shall not be carried onto structures such as bridge decks and cattle guards. Should this occur, the Contractor shall remove the material from the structures at his expense. Backblading may be required to remove excess material from the edges of such structures. The Contractor shall ensure there is a smooth transition on and off of the structures.

After crossing bridge structures and cattle guards, the Contractor shall immediately inspect the structures for any damage and, in the event any damage is evident, the Contractor shall immediately inform the Engineer of damage to any structure.



53.41.4.2 Maintenance of Gravel Roadways

The roadway shall be bladed to eliminate pot holes, washboards and ruts. All areas of standing water shall be drained. The patching of large potholes or depressions should be carried out in advance of the grading, in accordance with **Specification 53.44, “Gravel Pavement Pothole Patching”**.

When necessary scarify the existing surface with “Sandvik (System 2000) blades and bits” or equivalent, to cut to the bottom of any surface defects and loosen the material for reshaping.

The superelevation on curves shall be retained or restored over the entire roadway width. The Contractor shall be required to make as many passes as possible to achieve the acceptance criteria, specified below.

At intersections, the crown on the main roadway shall be maintained through the intersection. The crown on the intersecting roadway shall be feathered back.

Whenever possible, windrowed material shall not be left on the roadway overnight. If windrowed material must be left on the roadway overnight, it must be signed and barricaded to maintain safety to the satisfaction of the Engineer.

The Contractor shall make every effort to minimize the loss of gravel from the roadway surface when performing the Work.

When required by the Engineer, the Contractor shall supply and erect the following signs when performing Maintenance.

TEMPORARY SIGNS FOR MAINTENANCE					
Sign No.	Message or Description	Size (Centimetre)	Shape	Colour	
				Message	Background
WD-191	Grading 3km	75 x 75	Diamond	Black	Orange
WD-193	Grader Next 3km	75 x 75	Diamond	Black	Orange
WD-150	Loose Gravel	60 x 75	Rectangle	Black	White

Sign sizes, shapes, symbols and colours are to be in accordance with PNGS 1151 and PNGS 1152.

53.41.4.3 Preparation of Gravel Roadways

Gravel roadways shall be prepared such that the finished surface has defined shoulders, proper crown, and proper superelevation on curves. Loose gravel shall be retrieved from the roadway side slopes and spread over the roadway in a manner that provides a finished surface which is smooth and free of any large rock and other objectionable material such as grass clumps and sods.

53.41.5 ACCEPTANCE CRITERIA

Maintenance shall be performed to the satisfaction of the Engineer. Preparation of gravel roadways will be evaluated through visual inspection by the Engineer and shall comply with the following:

- The roadway surface is smooth and free of ridges, rocks and other material that may be hazardous to traffic;
- All pot holes, washboards, ruts and grass clumps have been eliminated;
- Roadway shoulders are well defined;
- At intersections, the crown on the main roadway has been maintained through the intersection



- while the crown on the intersecting roadway has been feathered back;
- The finished surface has a uniform crown of between 3% and 5%;
- Superelevation on curves is retained or restored;
- Existing gravel material has been retrieved from the side slopes as required;

53.41.7 MEASUREMENT AND PAYMENT

53.41.7.1 General

Measurement will be in Kilometres of gravel road maintained. Payment will not be made for travel, machinery maintenance, refueling, blade and other attachment installations and changes.

53.41.7.2 Maintenance and Preparation of Gravel Roadways

Payment will be made at the unit price per kilometre for "**Maintain/Prepare Gravel Surface Roads (Grader)**". This payment will be full compensation for supplying the grader complete with blades and all specified attachments, maintaining or preparing the roadway, signing, and all labour, equipment, tools and incidentals necessary to complete the Work.

53.41.8 WARRANTY

The warranty period for this Work is three (3) months.



53.42 SPOT GRAVELLING

53.42.1 GENERAL

The Work consists of the placing and spreading crushed gravel on roadways and approaches and other low volume work, generally in individual areas of less than one thousand square metres.

53.42.2 STANDARDS

Conform to the following Standards unless specified otherwise:

PNGS 1185 Methods for Sampling and Testing Aggregate.

AS 1289 Method of Testing Soils for Engineering Purposes.

53.42.3 MATERIALS

The Contractor shall pick up crushed gravel from a source approved by the Engineer or supply Gravel in accordance with following requirements:

53.42.3.1 Gravel

Obtain material from sources of naturally occurring deposits.

Produce required properties by crushing, screening, mixing or other processes necessary.

Ensure particles are tough, durable and of a tightly binding nature free of organic or other deleterious matter.

Conform to the tables GRAVEL PARTICLE SIZES and GRAVEL PROPERTIES.

53.42.3.1.1 TABLE - GRAVEL PARTICLE SIZES

AS SIEVE (mm)	PERCENTAGE PASSING	
	2	3
75.0		
37.5	100	
19.0	70 - 100	100
9.5	50 - 80	70 - 100
4.75	35 - 65	50 - 80
2.36	25 - 50	35 - 65
0.425	10 - 30	15 - 35
0.075	4 - 16	6 - 20

Gradings 2 and 3 are for Base and Shoulder.



53.42.3.1.2 TABLE - GRAVEL PROPERTIES

		UNSEALED BASE AND SHOULDER MATERIAL		
1.	Liquid Limit (LL)		35% maximum	
2.	Plasticity Index (PI)		4 - 12%	
3.	Linear Shrinkage (LS)		2 - 8%	
4.	PI x % passing 0.425 mm Sieve		400 maximum	
5.	California Bearing Ratio (CBR)		50 minimum	
	4 day soaked at 2.5 mm penetration at a relative density of		95% MMDD	
6.	Los Angeles Abrasion (LAA) Loss		50 maximum	

53.42.3.2 Sand Clay

A material complying with the following grading and properties:

53.42.3.2.1 TABLE – SAND CLAY GRADING

AS SIEVE (mm)	PERCENTAGE PASSING
4.75	80 - 100
2.36	60 - 100
0.425	30 - 60
0.075	14 - 28

53.42.3.2.2 SAND CLAY PROPERTIES

Plasticity Index: 20 maximum for sealed pavements
15 maximum for unsealed pavements.

Linear Shrinkage: 1% - 8%.

CBR, 4 day soaked at 95% MMDD
at 2.5 mm penetration: 50 minimum.

53.42.4 PROCEDURES

Spot Gravelling shall be conducted to pavement and shoulder washouts and blowouts in section lots less than 600m².

Equipment used for spreading gravel shall operate in the direction of normal traffic flow at all times.

Load, haul to site and dump gravel material.

There shall be no residual gravel remaining in the truck boxes after unloading.

Place, mix, compact and trim the material to the specified layer thickness in accordance with this section.

53.42.4.1 Placing and Mixing

The gravel shall be placed in one or more layers as designated by the Engineer. The application rate for each layer will be as shown in the Contract or as designated by the Engineer.

Following unloading, gravel shall be promptly and uniformly spread.

Place material in uniform layers over subgrade surface or lower layers of the pavement.



Remove segregated and contaminated material from the site.

Do not place material on a previous layer that has

- become waterlogged or cracked; and/or
- otherwise deteriorated.

Mix the material uniformly throughout with water to achieve a moisture content within 2% of the optimum for the specified conforming Dry Density Ratio.

Ensure water is clean and free from oil, alkali, organic or any other deleterious substances, and that the total soluble salts content is less than 3,000 mg/litre, total dissolved salts. Provide evidence of construction water salt contents if required by the Engineer.

53.42.4.2 Compaction

Compact in uniform layers not less than 100 mm nor greater than 200 mm compacted thickness.

Achieve a homogeneous mass with no compaction planes.

Conform to the Dry Density Ratios specified in the table DRY DENSITY RATIOS FOR CONFORMANCE.

53.42.4.2.1 TABLE - DRY DENSITY RATIOS FOR CONFORMANCE

Works Components	A Mean Dry Density Ratio (R) % ("n" is 3 to 5)	B Characteristic Mean Dry Density Ratio (Rc) % ("n" is 6 or greater)	
Natural surface to subgrade, fill, batters, table drain blocks, fill for water course, unpaved areas	90.0 or greater 89.9 or less	90.0 or greater 89.9 or less	Conformance Non-conformance
Subgrade, pavement, shoulders, select fill, levees,	95.0 or greater 94.9 or less	95.0 or greater 94.9 or less	Conformance Non-conformance
Stabilised pavement	95.0 or greater 94.9 or less	95.0 or greater 94.9 or less	Conformance Non-conformance

53.42.4.3 Trim Final Pavement Surface

Trim with a dense textured surface, free of laminations.

Remove sticks and any loose material.

Ensure surface is free of cracking.

Do not introduce new material to the surface after final compaction.

Where pavement thickness is 200 mm or greater, scarify to not less than 100 mm depth and recompact where finish not achieved.

Where pavement thickness is less than 200 mm scarify and recompact to full depth where finish not achieved.

Ensure a smooth and level transition between the repair area and the surrounding undisturbed pavement.



53.42.4 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer. To be acceptable, gravel must be spread smoothly and uniformly over the area being treated.

53.42.6 MEASUREMENT AND PAYMENT

53.42.6.1 General

Measurement will be in cubic metres of crushed gravel placed.

The capacity of the gravel hauling vehicles will be determined by the Engineer. The measurements will be to the nearest 0.1 m³ capacity, and the capacity of the vehicle, once measured, shall not be changed without the consent of the Engineer.

There will be no separate or additional payment when gravel surfacing is placed in more than one layer.

Payment for hauling if required will be made in accordance with **Specification 56.2: Hauling**.

53.42.6.2 Contractor Supply of Crushed Gravel

Payment will be made at the unit price bid per cubic metre for "**Spot Gravelling - Supply and Place**". This payment will be full compensation for supplying and spreading gravel surfacing material, and all labour, equipment, tools and incidentals necessary to complete the Work.

53.42.6.3 Department Supply of Crushed Gravel

Payment will be made at the unit price bid per cubic metre for "**Spot Gravelling - Pick up and Place**". This payment will be full compensation for picking up and spreading gravel surfacing material, and all labour, equipment, tools and incidentals necessary to complete the Work.

53.42.7 WARRANTY

There is no warranty period for this Work.



53.43 GRAVEL SURFACING (SHEETING)

53.43.1 GENERAL

The Work consists of placing and spreading crushed gravel on specified unsealed roadways as designated by the Contract. The area to be gravelled will usually be greater than one thousand square metres.

53.43.2 STANDARDS

Conform to the following Standards unless specified otherwise:

PNGS 1185 Methods for Sampling and Testing Aggregate.

AS 1289 Method of Testing Soils for Engineering Purposes.

53.43.3 MATERIALS

The Contractor shall either pick up crushed gravel from a source designated by the Engineer or supply crushed gravel in accordance with the following requirements

When the Contractor supplies the crushed gravel, the location of the source must be suitable to both the Department and the Contractor and will be agreed upon prior to the commencement of the Work.

53.43.3.1 Gravel

Obtain material from sources of naturally occurring deposits.

Produce required properties by crushing, screening, mixing or other processes necessary.

Ensure particles are tough, durable and of a tightly binding nature free of organic or other deleterious matter.

Conform to the tables GRAVEL PARTICLE SIZES and GRAVEL PROPERTIES.

53.43.3.1.1 TABLE - GRAVEL PARTICLE SIZES

AS SIEVE (mm)	PERCENTAGE PASSING	
	2	3
75.0		
37.5	100	
19.0	70 - 100	100
9.5	50 - 80	70 - 100
4.75	35 - 65	50 - 80
2.36	25 - 50	35 - 65
0.425	10 - 30	15 - 35
0.075	4 - 16	6 - 20

Gradings 2 and 3 are for Base and Shoulder.



53.43.3.1.2 TABLE - GRAVEL PROPERTIES

		UNSEALED BASE AND SHOULDER MATERIAL		
1.	Liquid Limit (LL)		35% maximum	
2.	Plasticity Index (PI)		4 - 12%	
3.	Linear Shrinkage (LS)		2 - 8%	
4.	PI x % passing 0.425 mm Sieve		400 maximum	
5.	California Bearing Ratio (CBR)		50 minimum	
	4 day soaked at 2.5 mm penetration at a relative density of		95% MMDD	
6.	Los Angeles Abrasion (LAA) Loss		50 maximum	

53.43.3.2 Sand Clay

A material complying with the following grading and properties:

53.43.3.2.1 TABLE – SAND CLAY GRADING

AS SIEVE (mm)	PERCENTAGE PASSING
4.75	80 - 100
2.36	60 - 100
0.425	30 - 60
0.075	14 - 28

53.43.3.2.2 SAND CLAY PROPERTIES

Plasticity Index: 20 maximum for sealed pavements
15 maximum for unsealed pavements.

Linear Shrinkage: 1% - 8%.

CBR, 4 day soaked at 95% MMDD
at 2.5 mm penetration: 50 minimum.

53.43.4 PROCEDURES

The work shall consist of the sheeting of pavement and shoulders with gravel, sand clay or other suitable approved materials.

Use gravel material complying with the MATERIALS clause.

Gravel sheet pavement and shoulders in section lots greater than 600 m².

Load, haul to site and dump gravel material.

Place, mix, compact and trim the material to the specified layer thickness in accordance with this section.

53.43.4.1 Placing and Mixing

Gravel shall be windrowed prior to final spreading. Gravel shall be promptly and uniformly spread before darkness each day. In unanticipated situations where gravel windrows must be left overnight, the windrow shall be signed in accordance with the **Department of Works Safety Guidelines**.

The gravel shall be placed in one or more layers as designated by the Contract. The application rate for



each layer will be as shown in the Contract or as designated by the Engineer.

Following unloading, gravel shall be promptly and uniformly spread.

Place material in uniform layers over subgrade surface or lower layers of the pavement.

Remove segregated and contaminated material from the site.

Do not place material on a previous layer that has

- become waterlogged or cracked; and/or
- otherwise deteriorated.

Mix the material uniformly throughout with water to achieve a moisture content within 2% of the optimum for the specified conforming Dry Density Ratio.

Ensure water is clean and free from oil, alkali, organic or any other deleterious substances, and that the total soluble salts content is less than 3,000 mg/litre, total dissolved salts. Provide evidence of construction water salt contents if required by the Engineer.

53.43.4.2 Compaction

Compact in uniform layers not less than 100 mm nor greater than 200 mm compacted thickness.

Achieve a homogeneous mass with no compaction planes.

Conform to the Dry Density Ratios specified in the table DRY DENSITY RATIOS FOR CONFORMANCE.

53.43.4.2.1 TABLE - DRY DENSITY RATIOS FOR CONFORMANCE

Works Components	A	B	
	Mean Dry Density Ratio (R) % ("n" is 3 to 5)	Characteristic Mean Dry Density Ratio (Rc) % ("n" is 6 or greater)	
Natural surface to subgrade, fill, batters, table drain blocks, fill for water course, unpaved areas	90.0 or greater	90.0 or greater	Conformance
	89.9 or less	89.9 or less	Non-conformance
Subgrade, pavement, shoulders, select fill, levees,	95.0 or greater	95.0 or greater	Conformance
	94.9 or less	94.9 or less	Non-conformance

53.43.4.3 Trim Final Pavement Surface

Trim with a dense textured surface, free of laminations.

Remove sticks and any loose material.

Ensure surface is free of cracking.

Do not introduce new material to the surface after final compaction.

Where pavement thickness is 200 mm or greater, scarify to not less than 100 mm depth and recompact where finish not achieved.

Where pavement thickness is less than 200 mm scarify and recompact to full depth where finish not achieved.

Ensure a smooth and level transition between the repair area and the surrounding undisturbed pavement.



53.43.5 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer. To be acceptable, gravel must be spread smoothly and uniformly over the area being treated.

53.43.6 MEASUREMENT AND PAYMENT

53.43.6.1 General

Measurement will be made in square metres of crushed gravel placed to the specified depth.

There will be no separate or additional payment when gravel surfacing is placed in more than one layer.

Payment for hauling if required will be made in accordance with **Specification 56.2, Hauling**.

53.43.6.2 Department Supply of Gravel Surfacing Material

Payment will be made at the unit price bid per square metre for “**Gravel Surfacing (Sheeting) - Pickup and Place**”. This payment will be full compensation for picking up and spreading gravel surfacing material, and all labour, equipment, tools and incidentals necessary to complete the Work.

53.43.6.3 Contractor Supply of Gravel Surfacing Material

Payment will be made at the unit price bid per square metre for “**Gravel Surfacing (Sheeting) - Supply and Place**”. This payment will be full compensation for supplying and spreading gravel surfacing material, and all labour, equipment, tools and incidentals necessary to complete the Work.

53.43.7 WARRANTY

There is no warranty period for this Work.



53.44 GRAVEL PAVEMENT POTHOLE PATCHING

53.44.1 GENERAL

This work shall include but not limited to the preparation of potholes, processing, loading, hauling, placement and compaction of approved basecourse material to provide a compacted interlocking gravel surface and a smooth transition to the surrounding gravel pavement.

53.44.2 STANDARDS

Conform to the following Standards unless specified otherwise:

PNGS 1185 Methods for Sampling and Testing Aggregate.

AS 1289 Method of Testing Soils for Engineering Purposes.

53.44.3 MATERIALS

53.44.3.1 Gravel

Obtain material from sources of naturally occurring deposits.

Produce required properties by crushing, screening, mixing or other processes necessary.

Ensure particles are tough, durable and of a tightly binding nature free of organic or other deleterious matter.

Conform to the tables GRAVEL PARTICLE SIZES and GRAVEL PROPERTIES.

53.44.3.1.1 TABLE - GRAVEL PARTICLE SIZES

AS SIEVE (mm)	PERCENTAGE PASSING		
	2	3	
75.0			
37.5	100		
19.0	70 - 100	100	
9.5	50 - 80	70 - 100	
4.75	35 - 65	50 - 80	
2.36	25 - 50	35 - 65	
0.425	10 - 30	15 - 35	
0.075	4 - 16	6 - 20	

Gradings 2 and 3 are for Base and Shoulder.



53.44.3.1.2 TABLE - GRAVEL PROPERTIES

		UNSEALED BASE AND SHOULDER MATERIAL		
1.	Liquid Limit (LL)		35% maximum	
2.	Plasticity Index (PI)		4 - 12%	
3.	Linear Shrinkage (LS)		2 - 8%	
4.	PI x % passing 0.425 mm Sieve		400 maximum	
5.	California Bearing Ratio (CBR)		50 minimum	
	4 day soaked at 2.5 mm penetration at a relative density of		95% MMDD	
6.	Los Angeles Abrasion (LAA) Loss		50 maximum	

53.44.3.2 Sand Clay

A material complying with the following grading and properties:

53.44.3.2.1 TABLE – SAND CLAY GRADING

AS SIEVE (mm)	PERCENTAGE PASSING
4.75	80 - 100
2.36	60 - 100
0.425	30 - 60
0.075	14 - 28

53.44.3.2.2 SAND CLAY PROPERTIES

Plasticity Index: 20 maximum for sealed pavements
15 maximum for unsealed pavements.

Linear Shrinkage: 1% - 8%.

CBR, 4 day soaked at 95% MMDD
at 2.5 mm penetration: 50 minimum.

53.44.3 PROCEDURES

Prior to the commencement of any pavement works, the Contractor is to confirm and agree with the Engineer, the Pothole Categories and or the extent of repairs. The Contractor shall not be paid for any works constructed in excess of the agreed extent. The Pothole Categories are as follows:

CATEGORY	SURFACE AREA (M ²)
A	Not greater than 0.25
B	0.25 or greater, but less than 1.0
C	1.0 or greater, but less than 2.5
D	2.5 or greater, but less than 4.0
D+	4.0 or greater

Potholes shall be prepared in the following manner for the placement and compaction of basecourse:



- Excavate all mud, dust, and loose material to a firm foundation and to a minimum depth of 150mm below existing pavement level;
- Cut pothole to achieve square straight edges with square corners with all sides undercut;
- Remove debris and any collected water;
- In dry conditions, moisten sides of the hole;
- Trim and compact formation;
- Basecourse fill repair material shall be applied in layers of not more than 2.5 nominal size and thoroughly compacted to a Characteristic Value of 100% of Maximum Dry Density.

53.44.4 SAMPLING AND TESTING

The Contractor shall retain copies of his supplier's QC testing results, and undertake the quality control testing and inspections as required by the Contractor's QC Program. The Contractor shall make available, all QC test and inspection results when requested by the Engineer. The Contractor shall supply material samples to the Engineer for QA (Audit) testing purposes when requested.

53.44.5 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer. To be acceptable, patches must provide a dense, smooth and level transition between the treated area and the adjacent undisturbed pavement surface. Any loose material must be removed and the site left in a clean condition.

The Contractor shall re-treat any failed areas at his expense.

53.44.6 MEASUREMENT AND PAYMENT

Pothole repair work shall be measured in accordance with the categories in Sub-Clause 53.10.3. The unit of measurement for pothole categories A, B, C, and D shall be by the number of potholes repaired with basecourse. The unit of measurement for potholes in category D+ shall be the plan area, in square metres, to the extent as agreed under Sub-Clause 53.44.3.

Payment shall be made at the billed rate and shall include all work necessary to prepare the pothole, supply, place and compact basecourse to potholes, to existing road levels.

The Contractor shall be responsible for all costs associated with the supply, delivery and construction of basecourse materials including any royalty payments to land owners for materials extracted from approved quarries. The cost of any such royalties shall be included for in the Bill of Quantity prices.

53.44.7 WARRANTY

The warranty period for this Work shall be 30 days.



53.61 ROADWAY AND RAISED MEDIAN CLEANING

53.61.1 GENERAL

The Work consists of removing soil and other debris from pavement surfaces and raised medians.

53.61.2 EQUIPMENT

When “pickup cleaning” is ordered, the Contractor shall either supply a pickup broom equipped with a gutter broom on each side for mechanical cleaning operations or supply hard bristle brooms and Engineer approved garbage bags for manual cleaning operations.

53.61.3 PROCEDURES

The debris shall be removed from the raised median and/or pavement surface. Debris shall not be deposited on roadway surfaces, shoulders or sidewalks. Disposal of debris adjacent to the roadway shall be subject to the approval of the Engineer.

Cleaning operations using mechanical equipment shall be carried out in the same direction as the flow of traffic and in a manner which prevents material from being cast into the flow of traffic or into drainage inlets.

Manual cleaning operations will be conducted in the opposite direction to the flow of traffic.

53.61.4 MEASUREMENT AND PAYMENT

Measurement will be in square metres of the raised median or roadway surface cleaned. When the width of the area to be cleaned is narrower than the broom used, the measurement will be based on the actual width of the broom (to a maximum value of 1.8 m) multiplied by the length of area cleaned. In all other cases, measurement will be made of the total area cleaned.

Payment will be made at the unit price bid per square metre for "Roadway Cleaning - Broom", "Roadway Cleaning - Pickup Broom", or "Raised Medians Cleaning". Payment will be full compensation for removing and disposing of debris from the roadway surface and/or raised median and all labour, material, equipment, tools and incidentals necessary to complete the Work.

In urgent situations where the Contractor is required to respond within 2 hours of the issuance of the Work Order, an additional payment will be made at the unit price bid per occurrence for "Roadway Cleaning - Premium". This payment will be full compensation for complying with the accelerated scheduling required to complete the Work.

53.61.5 WARRANTY

There is no warranty period for this Work.



53.62 SAW CUTTING OF ASPHALT CONCRETE PAVEMENT

53.62.1 GENERAL

The Work consists of vertical saw cutting of the existing asphalt pavement structure to facilitate the removal of the asphalt bound material.

53.62.2 EQUIPMENT

The equipment shall be capable of producing a smooth vertical saw cut without causing damage to the adjacent pavement.

53.62.3 PROCEDURE

The Contractor shall saw cut the asphalt concrete pavement to a depth which will allow removal of the material without causing damage to the adjacent pavement.

53.62.4 ACCEPTANCE CRITERIA

The Saw cut depth shall be equal to or greater than the specified cut depth, for a minimum of 95% total saw cut length. Rough, jagged or cracked edges will not be acceptable.

53.62.5 MEASUREMENT AND PAYMENT

Measurement will be in metres of the length Pavement Saw Cut. Payment will be made at the unit price per metre of "Saw Cutting of Asphalt Concrete Pavement". Payment will be full compensation for Labour, materials and equipment, pavement cleaning, saw cutting and removal of saw cutting debris, except when it is performed as a component of another Specification, in which case this Specification will be considered incidental to the Work.

53.62.6 WARRANTY

There is no warranty period for this Work.



53.63 PAINTED ROADWAY LINES

53.63.1 GENERAL

The Work consists of supplying road marking paint and or thermoplastic material, including glass beads for painting roadway lines on pavement surfaces. The various configurations of roadway lines are shown in the Department's Standard Drawings and Contract Specific Drawings.

53.63.2 STANDARDS

Conform to the following Standards and Publication unless specified otherwise:

PNGS 1151	Manual of Uniform Traffic Control Devices
AS /NZS 1580	Paints and Related Materials - Methods of Test.
AS /NZS 1906	Retroreflective Materials and Devices for Road Traffic Control Purposes.
AS 2009	Glass Beads for Road Marking Materials.
AS 2700	Colour Standards for General Purposes.
AS 4049.2	Paints and Related Materials -Thermoplastic Road Marking Materials.
AS/NZS 4049.3	Paints and Related Materials - Road Marking Materials - Waterborne Paint - For use with Drop on Beads.
APAS 0041/4	Road Marking Paint, Thermoplastic.
APAS 0041/5	Road Marking Paint, Water Borne.
NTTM	Materials Testing Manual.

53.63.3 MATERIALS

53.63.3.1 General

The Contractor shall supply the paint and glass bead materials subject to the approval of the Engineer. The Contractor shall be responsible for ensuring that the quality of the paint and beads supplied meets all the relevant Standards and the Department's specific requirements.

The Contractor shall provide the Engineer with the following information prior to commencing the Work:

- Names and mailing addresses of the suppliers and manufacturers;
- Paint formulation to be supplied;
- Written confirmation from the manufacturer that the materials to be supplied meet the aforementioned standards and requirements;

The Contractor shall advise the Engineer of any change in paint formulation.

The Contractor shall verify that all materials delivered and used in the Work are the type ordered.

No paint formulation shall be diluted or mixed with a different formulation or with any other material without the prior approval of the Engineer.

The Contractor shall prevent contamination of the materials. Paint shall be protected from freezing.



53.63.3.2 Road Marking Paint

Approved water based white road marking paint conforming to APAS 0041/5 and suitable for application by spray equipment in accordance with Test Method AS/NZS 1580.205.4 to asphalt and bituminous seal road surfaces and for use with Intermix drop-on spherical glass beads.

Australian Paint Approvals Scheme (APAS) Specifications: For paint types identified by an APAS specification code, conform to the specification represented by that code.

The Contractor shall submit a 'Certificate of Compliance' of the paint with the relevant Australian Standards or APAS specification.

53.63.3.3 Long Life Marking Materials

Thermoplastic cold applied resin or cement based product approved and recommended by the manufacturer for the purpose and conforming to the requirements of AS 4049.2 and APAS specification 0041/4.

The Contractor shall submit a 'Certificate of Compliance' of the material with the relevant Australian Standards or APAS specification.

53.63.3.4 Glass Beads

Use Intermix glass beads conforming to AS 2009 with the exception of size, and conforming to the following size distribution requirements:

SIEVE SIZE (Microns)	% RETAINED	% PASSING
1180	0 – 3	97 – 100
850	5 – 20	80 - 95
425	65 – 95	5 – 35
PAN	0 - 10	

The Contractor shall submit a 'Certificate of Compliance' of the glass beads with the relevant Australian Standard.

53.63.4 EQUIPMENT

The Contractor shall supply all equipment necessary to complete the Work.

53.63.4.1 Painting Truck

The painting truck shall be self-propelled and equipped to meet or exceed the following requirements:

Two paint tanks, each having a minimum capacity of 270 litres feeding three lines for a simultaneous two-colour application (two yellow directional dividing lines and one white edgeline).

Painting controls capable of adjusting the paint application for the length of dashed line required. Each spray gun shall have independent controls and adjustment mechanisms and Specification 53.20 Painted Roadway Lines shall be operated from the operator's compartment.

The compressors shall have a minimum rated capacity of 4.25 cubic metres per minute.

Bead dispensers shall be electrically controlled, air operated, gravity fed with controls to adjust the bead flow. The bead dispensers shall be fed from tanks capable of holding a minimum of 45 kilograms of beads.

A television vehicle guidance or a vehicle guidance system mounted on a retractable A-frame with a guide wheel and pointer system, to assist the operator in maintaining alignment on the existing lines.

A minimum of five spray guns and bead dispensers mounted in the following configuration:

- Three spray guns and three bead dispensers mounted on an independently-controlled boom located on the left side of the truck to paint the directional dividing lines. The outer two spray guns and bead dispensers shall be in a configuration that will produce two lines of equal width with the distance



between the two lines equal to the width of one line (100 mm). The inner spray gun and bead dispenser shall operate independently and shall be used to apply the directional dividing line where only a single directional dividing line is required. When a 200 mm wide line is required, 2 adjacent guns shall be used simultaneously.

- Two spray guns and two bead dispensers mounted on an independently controlled boom on the left side of the truck to apply the left edge line. When a 200 mm wide line is required 2 adjacent guns shall be used simultaneously.
- Equipped to apply white or yellow paint from the three spray guns mounted on the right-hand side of the paint truck and to switch from one colour to the other during operation.
- Control of both independent booms, all spray guns, bead dispensers and painting controls from the operator's compartment(s).

The Engineer may allow the use of alternate equipment, provided the Contractor demonstrates that such equipment is capable of achieving the desired end product.

53.63.4.2 Companion Vehicles

The painting vehicle shall be immediately followed by a crash attenuator vehicle consisting of a five ton truck equipped with a crash attenuator. The weight of the crash attenuator vehicle including ballast, flashing arrow board and truck mounted crash attenuator shall be 6,300 to 12,000 kg.

The crash attenuator vehicle shall be followed by a ½ tonne or larger truck acting as a pilot vehicle.

53.63.4.3 Safety Equipment

The painting truck and both companion vehicles shall be equipped with the following:

- A. A two-way radio for voice communication.
- B. An overhead revolving beacon with an amber lens a minimum of 180 mm high and 180 mm wide. The beacon shall be mounted on the top of the vehicle fully visible to traffic approaching from both front and rear.
- C. A sequential arrow board meeting the following specifications:
 - a. Minimum size 0.75 metres x 1.52 metres.
 - b. Minimum 25 amber sealed beam, hooded lamps
 - c. Fully adjustable light intensity on all arrow board lights.
 - d. Operating modes which include:
 - 1) sequential left arrow or chevron
 - 2) sequential right arrow or chevron
 - 3) sequential double arrow or chevron
 - 4) horizontal bar
 - 5) all four lamps in the extreme corners of the panel flashing simultaneously at 35-50 flashes per minute with the flashing light lit 50% of the time.
 - e. The arrow board shall be controlled from a console located in the vehicle cab.
 - f. The arrow board display shall be visible to traffic approaching the rear of the trucks.
- D. A "slow moving vehicle" sign. The sign shall be mounted at the rear of the vehicle and be visible to the public only when the painting truck is applying paint.
- E. A warning sign, mounted at the rear of the equipment, stating "wet paint keep off". The sign shall have standard warning colours with letters having a minimum height of 150 mm and shall be visible to the public only when the equipment is applying paint.



53.63.5 PROCEDURE

53.63.5.1 General

Line painting on highways with high traffic volumes shall be performed between Monday and Thursday inclusive, outside peak traffic periods, if so directed by the Engineer.

Operation of the painting truck against the flow of traffic is not permitted.

Materials loading is not permitted on the travel lanes of a roadway surface.

53.63.5.2 Operation of Companion Vehicles

The Contractor shall operate both companion vehicles in conjunction with the painting truck during the painting of all longitudinal lines. Companion vehicle operators shall not attempt to control traffic from inside the vehicle.

The actual operating parameters of the companion vehicles will be determined by the Contractor to safely accommodate traffic and will be based on site specific conditions such as sight distances, highway geometrics and traffic patterns and volumes. Typical operating parameters are as follows:

53.63.5.2.1 CRASH ATTENUATOR VEHICLE

The crash attenuator vehicle shall follow behind the painting truck at a distance of 50 to 400 metres. Typically, on 4 Lane highways the crash attenuator vehicle should closely follow the paint truck to encourage traffic to maintain the passing lane and not pull in behind the paint vehicle. On 2 Lane roadways, traffic should still be encouraged to pass both vehicles in one pass, however actual conditions may dictate that the crash attenuator vehicle give way to allow safe passing.

On Single Lane Roads the crash attenuator vehicle shall be driven in the travel lane to keep traffic from passing the painting truck.

53.63.5.2.2 PILOT VEHICLE

On 2 lane and 4 Lane Highways the pilot vehicle shall be operated as follows:

- (i) On a 4 Lane Highway, the pilot truck shall be driven in the same travel lane as the paint machine, following it at a constant distance of approximately two kilometres.
- (ii) On a 2 Lane Highway with a minimum 3 metre shoulder, the pilot truck shall be driven along the left shoulder, not straddling the left edge line and following the painting truck at a constant distance of approximately two kilometres.
- (iii) On a 2 Lane Highway with less than a 3 metre shoulder, the pilot truck shall travel from approach road to approach road and stop until the paint machine has cleared the next approach road. Approach road in this context includes local roads, farm entrances, field entrances, etc. The pilot truck, when stopped in an approach road, shall sit parallel to the highway in order that the signs and arrowboard are fully visible to traffic approaching from the rear.

53.63.5.3 Arrowboard Message

The crash attenuator vehicle, pilot truck and the painting truck shall display the same message at all times. The message shall be one of the following:

- On 2 Lane Highway - a bar (6 horizontal lights flashing) is preferred but if a bar cannot be shown on the type of arrow board used, the 4 corner lights flashing is an acceptable alternative.
- On a 4 Lane Highway - a right arrow when operating in the left lane and a left arrow when operating in the right lane.
- On a Single Lane Road - four flashing corner lights or a bar.



53.63.5.4 Areas to be Painted

The Contractor shall paint lane lines, continuity lines, edge lines and directional dividing lines on the highway sections, as directed by the Contract.

The Contractor shall ensure that painted lines match the existing lines exactly unless otherwise directed by the Engineer. When painting is required in areas where there are no existing lines or where revisions to the existing lines are required, these areas will be identified and laid out or spotted by the Engineer.

53.63.5.5 Pavement Surface and Atmospheric Conditions

In addition to the general restrictions specified in **Specification 51.2, General (For Maintenance Work)**, painting shall not be performed during the following conditions:

- When the temperature is below 0° C.
- When wind conditions cause overspray.
- During periods of rainfall.

Areas to be painted shall be clean and dry during the application of paint.

Areas to be painted shall be inspected by the Contractor to ensure they are clean, free of sand and debris, and suitable for painting.

The Contractor shall immediately notify the Engineer of any areas that in his opinion are unsuitable for painting. Sweeping, when directed by the Engineer, shall be performed by the Contractor.

53.63.5.6 Setting Out

Painted roadway lines and markings shall be in accordance with Department of Works Drawing: A1/45000B

For new work, set out line marking to the line pattern specified in accordance with the DoW Standard Drawings A1/45000B Pavement Markings, relevant contract specific drawings and with PNGS 1151, including the setting out of arrows, letters, numerals and chevrons.

In the case of Re-marking work, re-mark along the line of the existing line marking and to the tolerances specified for new work.

53.63.5.7 Paint and Bead Application

The Engineer will specify the application rate to be used for each section of highway. Paint shall be uniformly applied. Except for “wide lines” as designated, all painted lines shall be 100 mm wide. Glass beads shall be applied immediately following the paint application at a uniform application rate.

Apply the marking materials using a self-propelled mobile sprayer, hand sprayer, hand painting or hand screeding as directed by the Engineer.

Produce documented evidence to show that the spraying equipment has been calibrated in accordance with NTTM 405.1 or other equivalent Test Method approved by the Engineer.

Maximum application speed for Intermix glass beads is 12 km/hr.

Apply glass beads by low pressure or delivered by gravity dispenser.

The application rates specified for glass beads are the rates that shall be retained in the painted surface after 3 weeks of trafficking.

Produce markings free from ghosting and raggedness on the sides and ends and parallel with the general alignment of the carriageway with the lines level, uniform and free from streaks.



53.63.5.7.1 TABLE - APPLICATION RATES

Material	Longitudinal Markings	Transverse and Other Markings
Water borne Paint dry film thickness (excluding surface applied beads)	> 0.250 mm	> 0.250 mm
Water borne Paint wet film thickness (excluding surface applied beads)	> 0.400 mm	> 0.400 mm
Surface applied glass beads (rate retained in the paint surface)	Intermix glass beads > 300g/m ²	Intermix glass beads > 300g/m ²
Thermoplastic cold film thickness	> 1.5 mm	3.0 mm + 1.0 mm
Surface applied glass beads (rate retained in the painted surface)	Intermix glass beads > 300g/m ²	Intermix glass beads > 300g/m ²

53.63.5.7.2 LONGITUDINAL APPLICATION

Apply paint evenly to the road surface at the specified film thicknesses (Tolerance + 0.05 mm) and not more than five seconds after spraying apply the intermix glass beads. The loss in glass beads after three weeks traffic shall not exceed ten per cent of total applied.

On all work, apply one coat of paint and glass beads to the road in the direction of traffic flow, where possible.

For re-marking apply one coat of paint and glass beads to the surface in the direction of traffic flow, where possible.

Transverse and Other Marking Applications: Apply paint evenly to the road surface to the specified film thickness and immediately after apply an even application of 'drop-on' glass beads at the specified rates.

53.63.5.8 Removal of Incorrectly Painted Lines

All lines that are incorrectly painted by the Contractor or painted where no lines are specified shall be removed by the Contractor at his own expense and to the satisfaction of the Engineer. The method and equipment used by the Contractor to remove incorrectly painted lines will be subject to the approval of the Engineer.

53.63.6 SAMPLING AND TESTING

The Contractor shall retain copies of his supplier's QC testing results, and undertake the quality control testing and inspections as required by its QC Programme. The Contractor shall make available, all QC test and inspections results when requested by the Engineer.

All materials will be subject to further inspection, sampling and testing by the Department and the Contractor shall provide safe, convenient access, acceptable to the Engineer, for inspection and sampling of the materials, and shall cooperate in the inspection and sampling process when requested to do so.

53.63.7 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection of the works and a review of QC testing results by the Engineer. The Work will be considered acceptable under the following conditions:



- a. When the following dimensional criteria are met:
 - Painted lines do not exceed a dimensional width of 110 mm for specified 100 mm wide line. No tolerance below 100 mm is allowed for the specified 100 mm wide line.
 - Painted lines do not exceed a dimensional width of 210 mm for specified 200 mm wide line. No tolerance below 200 mm is allowed for the specified 200 mm wide line.
 - Painted direction dividing, lane dividing or continuity lines do not exceed a maximum dimensional length deviation of + / - 100 mm for specified 3.0 m length of line.
 - No spaces between painted direction dividing, lane dividing or continuity lines exceed a maximum dimensional length deviation of + / - 100 mm for specified 6.0 m or 3.0 m length or space.
 - the distance between the centre line of the marking and the centre line of the set out mark is less than 30 mm.
- b. All painted lines are uniform in thickness and free of tire tracking, with no splatter, excessive overspray or other defects.
- c. The apparent line of the markings is a smooth continuous alignment when viewed in the direction of the line.
- d. all paint and glass beads have been applied at the proper locations and in accordance with the drawings.
- e. any incorrectly painted lines or lines painted at improper locations have been removed to the satisfaction of the Engineer.
- f. glass beads have been uniformly applied at the specified application rate.

53.63.8 MEASUREMENT AND PAYMENT

53.63.8.1 Painting Roadway Lines

Measurement will be made in kilometres of the length of line painted. Separate measurements will be made for each colour of paint used. The space between “dashed lines” will not be measured for payment.

Payment will be made at the applicable unit price bid per line-kilometre for “**Painted Roadway Lines - White**” or “**Painted Roadway Lines - Yellow**” regardless of the specified width. These payments will be full compensation for inspecting the areas to be painted, supplying and applying the paint and glass beads and all labour, equipment, tools and incidentals necessary to complete the Work.

53.63.8.2 Painting Roadway Lines at Intersections and Interchanges

Separate measurements will be made of the number of intersections (per side of road) painted.

Payment will be made at the unit price bid per side for “**Line Painting - Intersections**”. These payments will be full compensation for the additional paint, glass beads and effort involved in painting roadway lines at these locations. These payments will be separate and additional to those made for “Painted Roadway Lines”.

Payment for "Line Painting - Intersections" will only be made in for those intersections where the Contractor is required to paint additional lane lines (turning lanes or acceleration/deceleration lanes) and will be based on the number of roadway sides of the intersection requiring line painting. For example, additional line painting required on both sides of a 2 lane undivided highway would be considered two sides.



53.63.8.3 Sweeping

Measurement and payment for sweeping will be made in accordance with **Specification 53.61, Roadway and Raised Median Cleaning**, as required.

53.63.9 WARRANTY

The warranty period for this Work shall be 60 days.



53.64 RAISED PAVEMENT MARKERS

53.64.1 GENERAL

The Work consists of supplying and installing raised reflective pavement markers (RRPMs), and replacing reflectors in previously installed markers.

53.64.2 STANDARDS

Conform to the following Standards and Publication unless specified otherwise:

PNGS 1151 Manual of Uniform Traffic Control Devices

53.64.3 MATERIALS

The Contractor shall supply all RRPM materials using STIMSONITE 953 markers fixed to the road surface as recommended by the manufacturer of the marker. Use adhesives as recommended by the manufacturer.

Use adhesives within the time recommended by the adhesive manufacturer.

If specified by the Contract, concrete reflectorized road edge markers shall be supplied in accordance with DoW Standard Drawings: A3/45029

53.64.4 PROCEDURE

Markers shall be installed at the locations and intervals as designated in the Contract. For skip line installations, the markers shall be centred in the space between the lines.

53.64.4.1 Pavement Preparation

Ensure each RRPM site is free of dirt, oil, grease, paint and any other material which would affect the bond of adhesive to the pavement.

Abrasive blast, chip, or burn pavements that cannot be cleaned by sweeping.

Check the moisture content of the surface immediately before application by the polyethylene film moisture test.

Do not place markers if the film moisture test indicates the presence of moisture.

53.64.4.2 Placing Markers

Markers shall be installed, and reflectors replaced, in accordance with the manufacturers' recommended installation procedures. The Contractor shall provide a copy of these procedures to the Engineer prior to commencing the Work.

Use marker types as follows:

- | | |
|---|-----------------------------|
| a. Centre line: | White, two way reflectors. |
| b. Lane line: | White, one way reflectors. |
| c. Left edge line: | Red, one way reflectors. |
| d. Right edge line adjacent to medians on dual carriageway Roads: | Yellow, one way reflectors. |

Place the reflectors to face the oncoming traffic.

Do not obscure the reflective faces by adhesive.

Surface finish to be smooth.



Discard markers which are not positioned correctly within the time recommended by the manufacturer for use of the adhesive. Remove adhesive from the road surface.

Do not place markers over joints in concrete pavement.

53.64.4.3 Concrete Road Edge Markers

Concrete reflectorized road edge markers shall be installed along the pavement edge in accordance with DoW Standard Drawings: A3/45029.

53.64.5 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection by the Engineer. To be acceptable:

- the marker base must be installed flush with the pavement surface;
- the reflector must be unbroken and clearly visible to traffic;
- the markers must be installed at the correct interval, parallel to centreline and are at the correct alignment; and,
- the entire installation is installed in accordance with the manufacturer's recommended procedures.

53.64.6 MEASUREMENT AND PAYMENT

Measurement will be made of the number of markers installed and/or the number of reflectors replaced.

Payment will be made at the unit price bid per marker for "**Raised Pavement Markers - Supply and Install**". This payment will be full compensation for supplying and installing the new markers complete with reflectors, and all labour, material, equipment, tools and incidentals necessary to complete the Work.

Payment will be made at the unit price bid per reflector for "**Raised Pavement Marker Reflectors - Supply and Replace**". This payment will be full compensation for removing the existing reflector, supplying and installing the new reflector, and all labour, material, equipment, tools and incidentals necessary to complete the Work.

Payment will be made at the unit price bid per marker for "**Concrete Road Edge Markers - Supply and Install**". This payment will be full compensation for supplying and installing the new concrete markers complete with reflectors, and all labour, material, equipment, tools and incidentals necessary to complete the Work.

53.64.7 WARRANTY

The warranty period for an installed pavement marker is 1 year. The warranty period for a replacement reflector is 30 days.



54.0 ROADSIDE MAINTENANCE SPECIFICATIONS

- 54.1 ROADSIDE VEGETATION CONTROL
- 54.2 CHEMICAL VEGETATION CONTROL
- 54.3 MAINTENANCE OF HIGHWAY SIGNS
- 54.4 PAINTING STEEL POSTS AND FRAMES AND SIGN STRUCTURES
- 54.5 GUIDE POSTS
- 54.6 REMOVE AND DISPOSE OF GUARDRAILS, CABLE BARRIERS AND POSTS
- 54.7 W-BEAM GUARDRAILS AND POSTS
- 54.8 CLEANING DRAINS
- 54.9 MAINTAINING DRAINS



54.1 ROADSIDE VEGETATION CONTROL

54.1.1 GENERAL

The Work consists of cutting all vegetation **100 mm or less** in stem diameter, **to a minimum height of 50mm and a maximum height of 150 mm** as measured from the ground line and the collection and disposal of roadside litter or rubbish

Unless otherwise specified in the Special Provisions, hand trimming of vegetation adjacent to structures shall be performed in conjunction with each occurrence of mowing.

For the purpose of this Specification, the term “Slashing” refers to the cutting, mowing and trimming of vegetation.

54.1.2 STANDARDS

All work shall conform to the following standards and requirements unless specified otherwise:

- | | |
|-------------|--|
| PNGS 1151.3 | Manual of Uniform Traffic Control Devices – Traffic Control Devices for Works on Roads |
| A 4373 | Pruning of Amenity Trees |
| NAASRA | Guide to Engineering Practice, Part 5 Intersection at Grade |

54.1.3 EQUIPMENT

The Contractor shall supply all equipment listed in the Contract. This may include, but not limited to the following:

- Tractors and Slashers
- Tractor and Batter / Reach Mower
- Hand held equipment including machetes, chainsaws and brushcutters.

Use the above plant configurations to complete all slashing operations simultaneously.

Tractors shall be equipped with roll over protection canopies, seat belts and four way flashers or a rotating light.

Suitable guards are to be in place on all machinery to prevent material being “sprayed” onto the road surface and endanger vehicles, persons or property.

Mowers shall also be equipped with 330mm x 410mm red flags mounted 450 mm above the deck height, marking the outer edges of the mower.

Fit vehicular trimmer and edge machines with arrow boards and vehicle mounted attenuators, ie. crash cushions. Do not trim grass with vehicular trimmer and edge machines on carriageways between the hours of 0600 hours and 1800 hours, Monday to Friday, excluding Public Holidays.

54.1.4 PROCEDURE

54.1.4.1 General

Cut all grass and vegetation including shrubs and trees with a butt size up to 100mm diameter.

Mowers shall travel in the direction of traffic when any part of the equipment is on the roadway surface.

Mowing and trimming shall be performed such that the resulting stand of growth **does not exceed a maximum cut of 50 mm and a minimum cut of 150 mm** in height above the ground and in a manner which minimizes debris from being deposited on the roadway surface.

Collect litter prior to cutting.



Cut grass to clean cut, not broken or ripped, using equipment capable of maintaining the health and appearance of the grass and ground cover

Cut steep batters or areas inaccessible to conventional slashers with hydraulically operated boom mounted cutting equipment or by handheld equipment and tools.

In this specification grass include clumps or tufts of grass growing on scalded areas, grass species that grow at faster rates than other species, and includes the whole of the plant including leaves, seed stems and seed heads.

Trim growth that cannot be cut with tractor mounted cutters with hand held equipment. Include at back of kerbs, around road furniture, road medians, splitter islands, traffic control devices, fence lines, barriers, trees, concrete or paving, culvert headwalls, bridges, grids, floodways, drains and drainage structures.

Trim overhead vegetation to minimum clearance height of 5.0 metres above the carriageway.

Trim grass on concrete, paved or bituminous surfaces to ground or surface level. Use of super heated steam for longer term treatment is permitted here, as is herbicide in accordance with Specification 54.2.

At bridges trim vegetation to a minimum of 2 metres behind bridge rails.

Re-cut any area which is not cut to the specified height above the ground.

Remove stones, grass, cuttings or other debris from the road pavement, shoulders, gutters, cycle paths, walkways or walk tracks, following slashing operations.

In the event the Engineer specifies that trimming is not required, slashing in the area of structures shall be performed such that the cut is within:

- **1.5 metres** of the structure in the direction of travel of the mower
- **0.3 metres** of the structure perpendicular to the direction of travel of the mower.

Contractor shall ensure that his activities do not cause rutting in the highway right of way or damage erosion control sites and reclamation sites.

The Contractor may bale or otherwise salvage cuttings and mowed material and retain possession of the material. Salvaged material shall be placed in a manner which will not create a hazard to traffic and shall be removed within one weeks of being produced.

54.1.4.2 Opening Slash

Cut grass, and all other plants and remove and dispose cuttings, litter and all other debris, for 3.6 metres, both sides of roadway from edge of pavement, sealed or unsealed, including side drains and inlets and outlets of culverts, protection works and around road furniture, ie nominal two cut width.

Cut other areas as directed.

54.1.4.3 Full Slash

Cut grass, and all other plants and remove and dispose cuttings, litter and all other debris, both sides of roadway from the edge of pavement, sealed or unsealed, to the edge of the road reserve or the cleared tree line within the road reserve, including side drains, cuttings, tops of batters at cuttings, fill batters, inlets and outlets of culverts, protection works, and around road furniture.

At intersections cut triangular areas joining points 30 metres back from intersection centreline along each leg to provide sight distance.

Cut other areas as directed.

54.1.4.4 Slash Table Drain Offlets

Cut each side of invert of v-shaped table drain offlet for 1.8 metre width, ie total width of cut 3.6 metres, nominally two cuts, for 50m length.

Cut each side and invert base of trapezoidal shaped table drain offlet, ie total width of cut 5.4 metres, nominally three cuts, for 50m length.



54.1.4.5 Slash Firebreaks

Cut firebreaks within the road reserve for 3.6 metre width, ie nominal two cut width, or 7.2 metres width, ie nominal four cut width, as specified by the Contract.

54.1.4.6 Slash and Rake Firebreak

Slash firebreaks within the road reserve.

Rake slashed material and windrow to one side.

54.1.4.7 Litter Collection and Disposal

Include litter collection and disposal as a part of slashing operations. Undertake collection of litter on area to be slashed prior to slashing.

Litter collection and disposal may also be ordered separately, and shall include full road reserve width.

Collect litter including:-

- Drums and containers
- Drink or food packages and plastic bags
- Rocks larger than 100mm
- Fallen trees, branches or timber
- Ant beds
- Abandoned vehicles or car bodies and parts, including tyres & tubes
- Dead animals
- Any other materials or rubbish which is 100mm or more higher than natural surface.

Dispose of all litter at Provincial or Municipal Government approved Waste Disposal Site.

54.1.4.8 Replacement of Damaged Roadside Furniture, Structures and Property

The Contractor shall ensure the works proceed with all due care in order to avoid damage to guide posts, signs, culverts or any roadside furniture, property, utility installations, vehicles, or the environment. Without limiting the Contractor's obligations under the General Conditions of Contract, the Contractor shall promptly repair or have repaired any damage to guide posts, signs, culverts or any roadside furniture, property, utility installations or environment resulting from the implementation of the works.

The Contractor shall immediately notify the Engineer or his representative of any such damage advising proposal for repairs at no cost to the Principal.

The Contractor shall ascertain the owner's wishes as to the timing of the repairs. Engage appropriately qualified tradespersons to carryout repairs to the satisfaction of the property owner and the Engineer.

After providing seven days notice to the Contractor, the Engineer reserves the right to settle any claims arising from the damage.

Settlement of damages by the Engineer will not relieve the Contractor of any responsibility under this clause. The Engineer will deduct any costs incurred in settling these claims from the Contractor's progress invoice.

54.1.4.9 Safety

The Contractor shall:

- carryout all work within the road reserve in accordance with the provisions of the Contractor's approved Traffic Control and Safety Plan.
- ensure the safe and proper operation and maintenance of all materials, equipment and tools used under the contract.
- ensure all personnel working in the road reserve wear fluro work vests.
- fit appropriate guards on cutting equipment and high mounted orange coloured hazard lights on all



plant, equipment and vehicles being utilized under the contract.

- fit all plant, equipment and vehicles with signs or signwriting which identifies the primary contractor and advises road users of the primary contractor's contact phone number
- Erect advance warning signs at both ends of the works area, within one kilometre of the actual works location, and relocate as works progresses;
- Erect signs and park plant, equipment and vehicles within the road reserve, so that they do not interfere or restrict sight lines, particularly at intersections
- Remove temporary works signs from site daily, do not leave on site overnight, or when there are no works in progress

54.1.4.10 Environment Protection

The Contractor shall comply with all provisions of the Contractor's approved Environment Management Plan. In addition the Contractor shall comply with the following requirements and allow for any associated costs in the bid price for the works:

- prevent any form of littering by all Contractor's personnel during the course of the works;
- remove all debris, surplus material, waste material or any form of spoil related to the works from the site;
- prevent any material from falling or being blown from vehicles;
- leave work site clean and tidy at the completion of each day's work. Do not allow refuse of any type to remain on site overnight;
- Comply with the relevant sections of the Provincial and Local Level Government laws, Environment Act 2000 and the Industrial Safety, Health and Welfare Act with regard to noise pollution;
- Ensure all plant and equipment complies with statutory regulations, is designed, installed, operated and maintained to minimize noise disturbance to residents and the general public;
- Comply with all regulatory guidelines and legislation with regard to the protection of water resources, rivers, streams, waterways and wetlands;
- ensure protection to any flora and fauna that may be affected by the works, particularly those which: have botanical, historical or cultural significance; have aesthetic or ecological significance, provide habitat for rare or endangered species and or have cultural or archeological heritage;
- Safeguard any historical or cultural relics and places within the road reserve. Where there is uncertainty as to the existence of sacred sites or relics, seek advice through the Engineer, from the National Museum.

54.1.5 ACCEPTANCE CRITERIA

Vegetation less than 100mm in stem diameter in the work area shall be 50 mm to 150 mm in height above the ground level.

Overhead vegetation shall be 5.0 m or more above the carriageway, when "Opening Slash" or "Full Slash" is specified.

The carriageway and shoulders shall be cleaned of all vegetation, cuttings and other debris at the end of each work day and completion of the work, when "Opening Slash" or "Full Slash" is specified.

Cut vegetation, debris, dead animals and other waste are disposed of properly at a disposal site(s) approved by the Engineer and the Provincial or Local Level Government.

All damage to the road pavement, road furniture, drainage structures, utility installations, private and other public property are reported and repaired to the satisfaction of the Engineer and the property owner.



54.1.6 MEASUREMENT AND PAYMENT

54.1.6.1 General

Separate measurement of areas trimmed will not be made. Trimming will be considered incidental to the Work and will not be paid for separately.

No payment will be made for areas Slashed by others.

54.1.6.2 Opening Slash

Opening Slash is measured in kilometres including both sides of road for each specified road.

Payment will be made at the unit price bid per kilometre for "Opening Slash". This payment will be full compensation for all labour, equipment, tools and incidentals necessary to complete the Work.

54.1.6.3 Full Slash

Full Slash is measured in kilometres including both sides of road for each specified road. Include for additional slashing on curves and at intersections to provide specified sight distance.

Payment will be made at the unit price bid per kilometre for "Full Slash". This payment will be full compensation for all labour, equipment, tools and incidentals necessary to complete the Work.

54.1.6.4 Slash Specific Areas

Slashing of specific areas other than road reserves is measured in square metres.

Payment will be made at the unit price bid per square metre for "Slash Specific Areas". This payment will be full compensation for all labour, equipment, tools and incidentals necessary to complete the Work.

54.1.6.5 Slash Table Drain Offlets

Slash Table Drain Offlets is measured by number of drain offlets.

Payment will be made at the unit price bid per drain offlet for "Slash Table Drain Offlets". This payment will be full compensation for all labour, equipment, tools and incidentals necessary to complete the Work.

54.1.6.6 Slash Firebreaks

Slash Firebreaks is measured in kilometres for nominated width.

Payment will be made at the unit price bid per kilometre for "Slash Firebreaks". This payment will be full compensation for all labour, equipment, tools and incidentals necessary to complete the Work.

54.1.6.7 Slash and Rake Firebreaks

Slash and Rake Firebreaks is measured in square metres.

Payment will be made at the unit price bid per square metre for "Slash and Rake Firebreaks". This payment will be full compensation for all labour, equipment, tools and incidentals necessary to complete the Work.

54.1.6.8 Litter Collection and Disposal

Litter collection and disposal is measured in kilometres including full width of road reserve both sides of road for each specified road.

Payment will be made at the unit price bid per kilometre for "Litter Collection and Disposal". This payment will be full compensation for all labour, equipment, tools and incidentals necessary to complete the Work.

Litter collection and disposal will not be measured and paid separately when included in the slashing items.



54.1.6.9 Replacement of Damaged Roadside Furniture and Structures

Replacement of damaged roadside furniture and structures due to the Contractor's slashing operations is not measured and paid separately. It shall be included in the slashing items.

54.1.7 WARRANTY

There is no warranty period for this Work.



54.2 CHEMICAL VEGETATION CONTROL

54.2.1 GENERAL

The Work consists of controlling weeds, grass, brush and small trees less than 2 m in height through the use of chemicals. The Work involves spraying with mobile equipment over relatively large areas and spot or hand spraying of small areas or areas which would normally be inaccessible to mobile equipment.

54.2.2 OPERATING APPROVALS AND PERMITS

The Contractor shall apply for an Environment Permit in compliance with the Environment Act 2000, from the Department of Environment and Conservation. All personnel applying for chemicals shall have a valid applicator's license issued by the Department of Agriculture and Livestock.

Special Environment Permits issued by the Department of Environment and Conservation will be required in instances where chemicals are to be sprayed within 30m of an open body of water. In such instances, the Contractor shall advertise the proposed work in newspapers and other mass media formats, local to the area, as may be required by the Secretary of the Department of Environment and Conservation, 30 days prior to the scheduled starting date of the Work. The Contractor shall provide the Engineer with a copy of the newspapers containing the advertisement and copies of other required media advertisements. All public concerns shall be referred, by the Contractor, to the Department of Environment and Conservation, who will identify any work conditions in the approval. The Contractor shall be responsible for obtaining the Special Environment Permit and shall comply with the conditions specified therein.

54.2.3 MATERIALS

The Contractor shall select and supply the appropriate chemical for vegetation control. Only chemicals jointly approved by the **Department of Works, the Department of Environment and Conservation, the Department of Forestry, the Department of Agriculture and Livestock and the Department of Fisheries**, for general industrial spraying shall be used. The Contractor shall supply any signs required to identify treated areas in public use areas.

The Contractor shall submit to the **Department of Works, the Department of Environment and Conservation, the Department of Forestry, the Department of Agriculture and Livestock and the Department of Fisheries** the list of herbicides and other chemicals intended for use during the contract, details of vegetation controlled by the herbicide, and duration of control per treatment.

The Contract shall use chemicals that are approved by the Australian Pesticides and Veterinary Medicines Authority (APVMA). All information pertaining to the use requirements of chemicals on the manufacturers' labels can be obtained from the Authority's web site <http://services.apvma.gov.au/>.

The Contractor shall only use herbicides that are biodegradable and do not contain lead arsenates or other substance or salts dangerous to humans or animals.

The Contractor shall use spreading agents if and as recommended on the labels.

The Contractor shall select and supply a dye approved by the **Department of Works, the Department of Environment and Conservation and the Department of Agriculture and Livestock**, to add to the chemicals, to visibly mark treated areas.

54.2.4 EQUIPMENT AND PERSONNEL

The Contractor shall be registered for business as weed control operator, or engage subcontractors registered for business as weed control operators.

The Contractor's Crew leaders carrying out spraying operations shall have undertaken and passed a Farm Chemical User Training Program recognised by the Department of Agriculture and Livestock.

The Contractor's Operators shall be competent in their understanding of how to prevent spray drift.



Use equipment recommended by the Chemical Manufacturer and calibrated to measure volume sprayed.

Wear as a minimum protective clothing in accordance with the chemical manufacturer's recommendations and/or directions as written on the labels which appear on the APVMA web site: <http://services.apvma.gov.au/>.

54.2.5 PROCEDURES

54.2.5.1 General

The Contractor's use of chemicals, application rates and methods shall comply with the policies, rules and regulations of the Department of Environment and Conservation, the Department of Forestry, the Department of Agriculture and Livestock and the Department of Fisheries.

Handle, transport, spray, store and dispose of chemicals and their containers in accordance with the manufacturer's specifications and/or directions as written on the labels which appear on the APVMA web site, to avoid environmental and health risks.

The Contractor shall maintain accurate records of all applications including the type and amounts of chemicals used and the locations treated. The Contractor shall supply this information to the Engineer along with copies of the bills of lading and the manufacturer's recommended application rates for the chemicals used.

54.2.5.2 Spraying

The Contractor shall apply chemicals to specified areas only and shall dispose of empty chemical containers at disposal sites pre-approved by the Department of Environment and Conservation.

The Contractor shall mix the dye with the chemical at the manufacturer's recommended rates. Do not spray on days of wind velocity greater than 15 km/h mean value and gusts do not exceed 19km per hour because of risk of spray drift causing a hazard on adjoining properties.

Do not cause spray drift. Prevent misting in breeze conditions by spraying at a lower pressure or adjusting spray nozzles to increase droplet particles, or other suitable means.

Do not spray near schools during school hours, or during outdoor activities at the school at any time. Spray only when wind is blowing away from the school.

Do not spray during rain or when vegetation is saturated.

54.2.5.2.1 AROUND GUIDE POSTS

Spray a minimum triangular area around guide posts having as its base the sealed edge of the road. The length of the base to be a minimum 8 metres centred on the guide post. The apex of the triangle to be 1 metre behind the guide post perpendicular to the road centreline through the guide post.

54.2.5.2.2 AROUND SIGN POSTS

Spray a minimum triangular area around sign posts having as its base the sealed edge of the road. The length of the base to be a minimum 5 metres long and positioned to extend 4 metres into the direction of the oncoming traffic and 1 metre past the line of the sign post. The apex of the triangle shall be 1 metre behind the sign post perpendicular to the road centreline through the sign post.

54.2.5.2.3 AT BRIDGES AND GUARD RAILS

Spray area within 1 metre of any part of the structure.

Spray area between the edge of the seal and a line 1 metre behind any guard rail and extending 10 metres beyond the guard rail at both ends.

54.2.5.2.4 AT FLOOD-WAYS AND CULVERTS

Spray incorporated rock protection works.



Slash area within 1 metre of the structure and protection works, in accordance with **Specification 54.1 – Roadside Slashing and Clearing**.

54.2.5.2.5 REST AREAS AND TRUCK-BAYS

Spray areas within 1metre of any part of furniture or structure.

Slash all other areas within the perimeter, in accordance with **Specification 54.1 – Roadside Slashing and Clearing**.

54.2.5.3 **Record Keeping**

The Contractor shall maintain daily log books for works undertaken under the contract, to include the following information:

- Description, ie category of work for measurement and payment
- Start/finish of spray locations by Road Number, Road Name, Section ID, Start Point Name, End Point Name, chainage and as GPS position.
- Time of spray application
- Product used
- Chemical mixture (eg Kg or litres per 100 litres of water)
- Rate of application (eg Kg per hectare, or Kg per kilometres sprayed).
- Type of spray equipment used (eg hand spray, vehicle mounted spray)
- Type of transport equipment used (Mounted spray Ute, Truck, quad, by hand)
- Target weeds
- Weather conditions (eg rainfall, temperature, wind velocity and direction)
- Name of applicator
- Any unusual happenings on the site
- Results of application: Include date this information is added.

The Contractor shall submit daily log book sheets to the Engineer, with invoice for payment.

54.2.6 **METHOD OF APPLICATION**

Areas of application will be defined as:

54.2.6.1 **Mobile Spray - On Road**

Continuous treatment areas within the right-of-way with a minimum width of 1.5 m which:

- consist of at least 3 ha in 20 km of roadway length in not more than two individual areas (areas that cannot be sprayed due to landowner objections, environmental concerns, et cetera are not considered breaks in continuous areas).
- are adjacent to and extend up to 14 m from the road shoulder edge, and
- are of a constant width. (full right-of-way is considered a constant width even though the right-of-way may vary)

54.2.6.2 **Mobile Spray - Off Road**

Continuous treatment areas within the right-of-way, which:

- consist of at least 3 ha in 20 km of roadway length in not more than two individual areas (areas



- that cannot be sprayed due to landowner objections, environmental concerns, et cetera are not considered breaks in continuous areas);
- are outside of 14 m from the shoulder edge;
 - are of a constant width. (up to the right-of-way is considered a constant width even though the right-of-way may vary; and
 - are mobile accessible and for which it is desirable to utilize off-road equipment.

54.2.6.3 Mobile Spot Spray - On-Road

All areas not defined as "Mobile Spray- On Road", "Mobile Spray - Off Road", "Mobile Spot Spray - Off-Road" or "Hand Spray".

54.2.6.4 Mobile Spot Spray - Off-Road

Intermittent areas within the right-of-way, outside of 14 m from the shoulder edge which are mobile accessible and for which it is desirable to utilize off-road equipment. For example: certain slopes, fence lines, property lines, etc.

54.2.6.5 Hand Spray

All small select areas within the right-of-way, not accessible to any type of mobile equipment.

54.2.7 ACCEPTANCE CRITERIA

The Work will be considered acceptable under the following conditions:

- All specified areas have been visibly treated and at least 75% of the vegetation shows growth retardation 10 days after spraying.
- At least 90% of the vegetation shows growth retardation 40 days after spraying.
- No areas outside the specified areas show chemical damage.
- The Contractor has provided the Engineer with accurate records of the locations treated and the types and amounts of chemicals used.

54.2.8 MEASUREMENT AND PAYMENT

54.2.8.1 General

Measurement of chemical vegetation control will be in kilometers, hectares or square metres depending on the method of application. Areas will be measured and paid for only once per Contract regardless of the number of times the area is treated. The minimum width used for calculating the area for "Vegetation Control - Mobile Spray", will be 1.5 metres.

When the Contract specifies that a pilot vehicle and/or arrowboard is required for traffic control, measurement for the Pilot Vehicle will be per Pilot Vehicle unit. Payment will be at the unit price bid for "Pilot Vehicle for Traffic Control". This payment will be full compensation for the supply and use of Pilot Vehicle, all travel, transport, labour, materials, equipment, tools and incidentals necessary to complete the Work. The arrowboard will be paid for in accordance with Specification 56.38, Supply of Arrowboards for Traffic Control.

54.2.8.2 Mobile Spray - On-Road

Payment for chemical vegetation control using on-road, mobile equipment will be made at the unit price bid per kilometer, including both sides of road for each specified road, for "Vegetation Control - Mobile Spray - On-Road". This payment will be full compensation for obtaining all necessary approvals and permits, the supply of chemicals and dye, spraying the vegetation using on-road, mobile equipment, and all



labour, equipment, tools and incidentals necessary to complete the Work. No payment will be made for materials used for any additional applications required to achieve compliance with the Acceptance Criteria.

54.2.8.3 Mobile Spray - Off-Road

Payment for chemical vegetation control using off-road, mobile equipment will be made at the unit price bid per hectare for "Vegetation Control - Mobile Spray - Off-Road". This payment will be full compensation for obtaining all necessary approvals and permits, the supply of chemicals and dye, spraying the vegetation using off-road mobile equipment, and all labour, equipment, tools and incidentals necessary to complete the Work. No payment will be made for materials used for any additional applications required to achieve compliance with the Acceptance Criteria.

54.2.8.4 Mobile Spot Spray - On-Road

Payment for spot chemical vegetation control using on-road, mobile equipment will be made at the unit price bid per kilometer, including both sides of road for each specified road, for "Vegetation Control - Mobile Spot Spray - On-Road." This payment will be full compensation for obtaining all necessary approvals and permits, the supply of chemicals and dye, spraying the vegetation using on-road, mobile equipment, and all labour, equipment, tools and incidentals necessary to complete the Work. No payment will be made for materials used for any additional applications required to achieve compliance with the Acceptance Criteria.

54.2.8.5 Mobile Spot Spray - Off-Road

Payment for spot chemical vegetation control using off-road, mobile equipment will be made at the unit price bid per hectare for "Vegetation Control - Mobile Spot Spray - Off-Road." This payment will be full compensation for obtaining all necessary approvals and permits, the supply of chemicals and dye, spraying the vegetation using off-road, mobile equipment, and all labour, equipment, tools and incidentals necessary to complete the Work. No payment will be made for materials used for any additional applications required to achieve compliance with the Acceptance Criteria.

54.2.8.6 Hand Spray

Payment for spot vegetation control using hand equipment will be made at the unit price bid per square metre for "Vegetation Control - Hand Spray." This payment will be full compensation for obtaining all necessary approvals and permits, the supply of chemicals and dye, hand spraying the vegetation, and all labour, equipment, tools and incidentals necessary to complete the Work. No payment will be made for materials used for any additional applications required to achieve compliance with the Acceptance Criteria.

54.2.9 WARRANTY

There is no warranty period for this Work.



54.3 MAINTENANCE OF HIGHWAY SIGNS

54.3.1 GENERAL

The Work consists of the manufacture, supply, delivery and erection of road signs.

54.3.2 Standards

Conform to the following Standards and Publication unless specified otherwise:

PNGS 1047	Steel Tubes and Tubulars for Ordinary Services.
AS /NZS 1111	ISO Metric Hexagon Commercial Bolts and Screws.
AS /NZS 1112	ISO Metric Hexagon Nuts, Including Thin Nuts, Slotted Nuts and Castle Nuts.
AS 1397	Steel Sheet and Strip Hot Dipped Zinc Coated or Aluminium/Zinc Coated.
AS 1604	Timber – Preservative Treated – Sawn and Round.
AS 1722	Pipe Threads of Whitworth Form.
AS /NZS 1734	Aluminium and Aluminium Alloys - Flat Sheet, Coiled Sheet and Plate.
PNGS 1151	Manual of Uniform Traffic Control Devices.
PNGS 1152	Road Signs - Specifications.
AS 1744	Forms of Letters and Numerals for Road Signs.
AS /NZS 1906	Retroreflective Materials and Devices for Road Traffic Control Purposes.
AS 2700	Colour Standards for General Purposes.

54.3.3 MATERIALS

All materials supplied by the Contractor shall be in compliance with the relevant Papua New Guinea and/or Australian Standards. The Contractor is responsible for ensuring that the material provided meets the specified characteristics.

The Contractor shall supply all signs in accordance with the Schedule of Signs in the Contract, or as specified by the Engineer.

For the purpose of this specification, the type of sign supplied shall be defined as "Standard" or "Non-Standard".

The Contractor shall ensure that all signs are marked with the name of the manufacturer and the date of manufacture.

54.3.3.1 Non-Reflective Materials

Non-reflective materials to be in accordance with PNGS 1152 and AS 2700.

54.3.3.2 Reflective Material

The Contractor shall use high intensity Class 1 standard in accordance with AS/NZ 1906 for all signs, including temporary signs, and hazard markers with the exception that all black legends are to be non-reflective.

54.3.3.3 Blanks

The Contractor shall use aluminium marine grade alloy designation 5251 - H38. Thickness 1.6 mm.

Steel sheets, Extruded Aluminium and 3/4" Plywood, may be used for non-standard or temporary signs.



54.3.3.4 Manufacture

The Contractor shall chemically clean aluminium blanks before painting or bonding of reflective material.
The month and year of manufacture shall be stamped on the backs of all signs.

54.3.3.5 Posts

The post sizes shall conform to AS1074 and the table: ROADSIDE SIGNS - MOUNTING SELECTION, unless specified otherwise by the Engineer.

Posts to be medium grade galvanized pipe with plain ends and constructed from a single length of pipe. Cap each post with a galvanized cap.

54.3.3.6 Supply and Delivery

The Contractor shall supply all brackets, bolts, nuts and bracings. Bracings shall be fixed to the signs prior to delivery.

54.3.4 PROCEDURE

54.3.4.1 General

The Contract will specify the type of sign required including:

- Dimensions of the sign
- Dimensions of the lettering;
- Colours of the sign;

This Work shall be completed in conjunction with the installation of the sign and the supply and installation of the sign post where applicable. All signs shall be supplied in sufficient time to meet the installation requirements.

54.3.4.1.1 TABLE: ROADSIDE SIGNS - MOUNTING SELECTION

SIGN SIZE W X D	NO. AND NB GAL. PIPE POSTS	SIGN ATTACHMENT BRACKETS (OR M8 BOLTS) PER POST	BRACING	ANCHOR	
				DEPTH (mm)	DIA. (mm)
300 x 300	1 x 50	2	No	600	300
300 x 450	"	"	"	"	"
450 x 450	"	"	"	"	"
450 x 300	"	"	"	"	"
450 x 600	"	"	"	"	"
450 x 750	"	"	"	"	"
450 x 900	"	"	"	"	"
600 x 450	"	"	"	"	"
600 x 600	"	"	"	"	"
600 x 750	"	"	"	"	"
600 x 900	"	3	"	"	"
600 x 1050	"	3	"	"	"



Specification 54.3
Maintenance of Highway Signs

SIGN SIZE W X D	NO. AND NB GAL. PIPE POSTS	SIGN ATTACHMENT BRACKETS (OR M8 BOLTS) PER POST	BRACING	ANCHOR	
				DEPTH (mm)	DIA. (mm)
750 x 450	"	2	"	"	"
750 x 600	"	2	"	"	"
750 x 750	"	2	"	"	"
750 x 1200	"	3	"	1000	"
900 x 300	"	2	Yes	600	"
900 x 600	"	2	"	"	"
900 x 900	"	3	"	"	"
900 x 1350	"	4	"	1000	"
1050 x 600	"	2	"	"	"
1050 x 900	"	3	"	"	"
1200 x 600	2 x 50	2	"	600	"
1800 x 600	2 x 50	2	"	1000	"
1800 x 1200	2 x 80	4	"	"	"
2400 x 1200	2 x 80	4	"	1200	450
2400 x 1800	2 x 100	5	"	"	"
3000 x 600	2 x 50	2	"	1000	300
3000 x 1200	2 x 80	4	"	1200	450
3000 x 1800	2 x 100	5	"	1500	"
3700 x 600	2 x 80	2	"	1000	300
3700 x 1200	3 x 80	4	"	1200	450
3700 x 1800	3 x 100	5	"	1500	"
3700 x 2400	4 x 100	7	"	1500	"
4300 x 600	2 x 80	2	"	1000	300
4300 x 1200	3 x 80	4	"	1200	450
4300 x 1800	3 x 100	5	"	1500	"
4900 x 600	3 x 80	2	"	1000	300
4900 x 1200	3 x 100	4	"	1200	450
4900 x 1800	3 x 100	5	"	1500	"
5500 x 600	3 x 80	2	"	1000	300
5500 x 1200	3 x 100	4	"	1200	450
5500 x 1800	4 x 100	5	"	1500	"
6100 x 600	3 x 80	2	"	1000	300



SIGN SIZE W X D	NO. AND NB GAL. PIPE POSTS	SIGN ATTACHMENT BRACKETS (OR M8 BOLTS) PER POST	BRACING	ANCHOR	
				DEPTH (mm)	DIA. (mm)
6100 x 1200	3 x 100	4	"	1200	450
6100 x 1800	4 x 100	5	"	1500	"

54.3.4.1.2 GENERAL REQUIREMENTS

- Spacing between posts: 2 post signs - 0.6 times sign width.
3 post signs - 0.4 times sign width.
4 post signs - 0.3 times sign width.
- Brace spacing to be 380 mm maximum.
- Adopt the nearest size in the list for intermediate sizes.
- Post sizes for galvanized pipe posts are for sign clearance of less than 2 m above the pavement. For sign clearances greater than 2 m, increase the nominal diameter of the pipe size by a percentage equal to the percentage increase in height above 2 m.
- Where signs are erected in groups treat the overall dimensions of the group as one sign size to determine the post requirement from the table ROADSIDE SIGNS - MOUNTING SELECTION.

54.3.4.2 Location

Signs shall be located as specified by the Contract, clear of vegetation and be clearly visible under headlight illumination.

54.3.4.3 Lateral Placement

Lateral placement to be measured to the edge of the sign nearest the road.

Lateral placement to be as follows:

- Unkerbed roads: 2 to 4 m clear from the edge of the traffic lane, and 600 mm minimum clear from the outer edge of the road shoulder.
- Kerbed roads: 500 mm to 1000 mm from the front face of the kerb.

54.3.4.4 Height

Height to be measured as the clearance to the lowest edge of the lowest sign in an assembly.

Heights for signs to be as follows:

Unkerbed Roads:

- Fingerboard (G3) and street name signs (G5): 2 m above the near edge of the pavement.
- Other signs: 1 m to 1.5 m above the near edge of the pavement.

Kerbed Roads:

- Signs overhanging a footway: 2.5 m minimum above footway.
- Signs not overhanging a footway: 1 m to 1.5 m clearance except for those specific signs on medians and islands given below.
- Specific signs on medians: The following signs, when used on medians and islands, to have a



and islands: clearance 150 mm above the kerb:

- D4-1-2 Hazard Marker
- D4-2-2 Hazard Marker
- D4-3 Hazard Marker
- R2-3 (Keep Left) (Keep Right)
- R2-5 (No U Turn)
- R2-6 (No Right Turn) (No Left Turn)
- R2-15 (U Turn Permitted).

54.3.4.5 Installation

The installation of signs shall conform to the table ROADSIDE SIGNS - MOUNTING SELECTION and the Contract Drawings.

All sign support Posts are to be vertical.

Sleeves, when specified, to be 50 mm longer than the specified ground anchor depth and extend 50 mm above the finished surface level.

Attach the post to the sleeve with a galvanized M10 bolt, 25 mm from the top of the sleeve. Encase the post, or sleeve when used, in a footing of 20 MPa concrete.

Orientation of sign face: Vertical, and turned 3 degrees to 5 degrees horizontally from oncoming traffic on straight sections. On curves, at right angles to centre line of road.

Exception: Parking signs to be oriented 5 degrees from parallel to the kerb to face oncoming traffic.

54.3.4.6 Reinstatement and Relocation of Existing Signs

Dismantle existing post and signs carefully.

Store sign and post in a manner to prevent damage.

Remove footing and backfill the hole left by the post and its footing and compact the fill to the same density as the surrounding area.

Erect signs in new locations as shown on the Contract Drawings.

Supports and bases shall be replaced with the same size unless otherwise specified in the Contract.

Signs on utility posts shall be mounted using procedures approved by the utility owner. The Engineer will determine when signs are to be banded to utility poles.

Existing signs, supports and bases shall be salvaged and reused wherever possible.

Remove waste material and dispose at a dump approved by Provincial or Municipal authority.

54.3.5 ACCEPTANCE CRITERIA

54.3.5.1 Supply of Signs

The Work will be accepted when the materials conform to the following requirements:

54.3.5.1.1 SHEETING MATERIAL

Lettering and symbols shall be clear and legible and of the required retro-reflectivity. The sheeting shall be applied free of blistering, delaminations, peeling or chipping, with no discolouration or fading.

54.3.5.1.2 BACKING (SUBSTRATE)



54.3.5.1.2.1 Wood

Panels shall be straight and smooth with no warping, bending, twisting or splitting; and shall be sealed to prevent swelling.

54.3.5.1.2.2 Aluminum

Aluminum panels shall be straight with no warping, bending, twisting or splitting and shall not tear or deform at connections.

54.3.5.2 Installation of Signs

Evaluation of the Work will be based upon a visual inspection by the Engineer.

The Work will be considered acceptable when; sign(s) and supports are plumb and level; all signs, supports and other components are installed according to the applicable drawings; concrete bases are the correct distance out of the ground; all breakaway steel support surfaces are protected by galvanizing or zinc-rich paint; the work site is left clean; and the correct colour, spelling or symbols are on the sign provided.

The installed sign, support and frame shall be clean and not bent or twisted. Reflectorized surfaces shall be free of scratches and marks and must be securely fastened to the post or frame.

Any measurement for plumb and level will be done using a rigid two-foot hand level.

54.3.6 MEASUREMENT AND PAYMENT

54.3.6.1 General

Measurement for supplying signs will be made in square metres of the actual surface area of each sign of the applicable type and category.

When a sign contains more than "one print", measurement will also be made of the number of extra ink prints required to manufacture the completed sign. A two colour sign is considered to be one print; that is, the background colour plus a one colour message. A three colour sign requires two printings and a four colour sign requires three printings.

54.3.6.2 Standard Signs

Bid items for Standard Signs will be categorized according to size ranges. Payment will be made at the unit price bid per square metre (actual area) for a one print sign under the applicable category as follows:

- Supply Standard Signs, 0.27 m² and under;
- Supply Standard Signs, 0.28 m² to 0.45 m²
- Supply Standard Signs, 0.46 m² to 0.56 m²
- Supply Standard Signs, 0.57 m² to 1.44 m²
- Supply Standard Signs, 1.45 m² to 2.19 m²
- Supply Standard Signs, 2.20 m² to 4.39 m²;
- Supply Standard Signs, 4.40 m² to 6.59 m²;
- Supply Standard Signs, 6.60 m² to 8.79 m²;
- Supply Standard Signs, 8.80 m² and over

Payments will be full compensation for supplying the one-print signs to the worksite, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

When extra prints are required, they will be paid for at the unit price bid per print for "Extra Prints." This payment will be full compensation for all labour, materials, equipment, tools and incidentals necessary to complete the Work.



54.3.6.3 Non-Standard Signs

Payment for Non-Standard Signs will be made at the applicable unit price bid per square metre for "Supply Non-Standard Signs - 3/4" Plywood " or "Supply Non-Standard Signs - Extruded Aluminum " or "Supply Non-Standard Signs – Steel Sheet". Payments will be full compensation for supplying the signs to the worksite, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

54.3.6.4 Sign Supports

54.3.6.4.1 STEEL PIPE SIGN SUPPORTS

Measurement will be made of the number of steel pipe posts supplied and installed within a particular size range.

Measurement will be made of the number of steel pipe posts removed and disposed of, and the number of steel posts removed, salvaged and reinstalled.

54.3.6.4.1.1 Steel Pipe Supports - Supply and Install

Payment for supplying and installing steel posts will be made at the applicable unit price bid per post for:

- "Supply and Install NB50 Gal Steel Pipe Posts";
- "Supply and Install NB80 Gal Steel Pipe Posts";
- "Supply and Install NB100 Gal Steel Pipe Posts",

This payment will be full compensation for supplying and installing the post, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

54.3.6.4.1.2 Steel Pipe Supports - Remove and Reinstall

Payment will be made at the unit price bid per steel post for "Remove and Reinstall Steel Pipe Posts". This payment will be full compensation for removing and salvaging the steel post and sign, hauling salvaged material to the new site, reassembling and installing the support(s) and sign, and all labour, equipment, tools and incidentals necessary to complete the Work.

54.3.6.4.1.3 Steel Pipe Supports - Remove and Dispose

Payment will be made at the unit price bid per steel post for "Remove and Dispose Steel Pipe Posts" regardless of the size or length of the support.

This payment will be full compensation for removing and disposing of the steel post, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

54.3.6.5 Signs

54.3.6.5.1 INSTALL SIGN

Measurement will be made of the number of signs installed within a particular size range. When reinstalling signs on an existing salvaged, or new cluster frame or wind frame, the total area will be measured and considered a single sign.

Payment will be made at the applicable unit price bid per sign for:

- "Install Sign - less than 1 m²";
- "Install Sign - 1 m² to 3 m²";
- "Install Sign - 3 m² to 5m²";
- "Install Sign – 5m² to 8m²";
- "Install Sign – over 8m²"

This payment will be full compensation for delivering signs to the site when necessary, removing and salvaging or removing and disposing of the existing sign, installing the new or salvaged sign, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.



54.3.6.5.2 REMOVE SIGN

Measurement will be made of the number of signs removed and disposed of or removed and salvaged within a particular size range. When several signs are being removed from a single support, the total area of the signs removed will be measured and considered a single sign. When existing signs are being removed from a cluster frame or wind frame, the total area will be measured and considered a single sign.

Payment will be made at the applicable unit price bid per sign for:

- "Remove Sign - less than 1 m²"
- "Remove Sign - 1 m² to 3 m²"
- "Remove Sign - 3 m² to 5m²";
- "Remove Sign – 5m² to 8m²";
- "Remove Sign – over 8m²"

Payments will be full compensation for removing, salvaging and storing the sign or removing and disposing of the sign, and all labour, materials, tools and incidentals necessary to complete the Work.

The payment for "Remove Existing Sign" will only be applicable when the sign is not replaced.

54.3.6.5.3 SIGNS ON OVERHEAD STRUCTURES AND BRIDGE STRUCTURES

Measurement will be made of the area in square metres of each sign installed or removed from an overhead structure or bridge structure.

Payment will be made at the unit price bid per square metre for "Install Sign on Overhead Sign Structure or Bridge Structure" or "Remove Sign on Overhead Sign Structure or Bridge Structure". Payment for installation will be in addition to the payment for supply of the sign. Payments will be full compensation for installing or removing the sign from the overhead sign structure and all labour, materials, tools and incidentals necessary to complete the Work.

Payment for site specific traffic accommodation and signing will be paid separately in accordance with Specification 56.62, Supply of Flagperson for Emergency Traffic Control and/or Specification 56.38, Supply of Arrowboards for Traffic Control.

54.3.6.6 Install and Remove Concrete Bases

Measurement will be made of the number of bases supplied and installed, bases removed, salvaged and reinstalled and bases removed and disposed of.

Payment for supplying and installing concrete bases will be made at the unit price bid per base for "Supply and Install Concrete Base".

Payment for removing, salvaging and reinstalling existing bases will be made at the unit price bid per concrete base for "Remove and Reinstall Concrete Base".

Payment for removing and disposing of concrete bases will be made at the unit price bid per base for "Remove and Dispose Concrete Base".

These payments will be full compensation for all labour, materials, equipment, tools and incidentals necessary to complete the Work.

54.3.6.7 Supply and Install, or Remove and Dispose, Cluster and Wind Frames

Measurement will be made in square metres of the area bounded by the outside edge of the cluster frame or wind frame installed or removed.

Payment will be made at the unit price bid per square metre for "Supply and Install Cluster Frames", or "Supply and Install Wind Frame". Payments will be full compensation for the supply of the frames, removal and disposal of existing frames, installation of the new frame, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.



54.3.6.8 Girts

When girts are requested by the Engineer, they will be measured and paid for at the unit price bid per metre for "Supply and Install Reinforcing Girts". This payment will be full compensation for supplying and installing reinforcing girts, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

54.3.6.9 Banding Signs

Measurement will be made of the number of signs banded to a structure.

Payment for banding signs will be made at the unit price bid per sign for "Banding Signs". This payment shall be full compensation for the supply and installation of banding material, and all labour, materials, tools and incidentals necessary to complete the Work.

54.3.7 WARRANTY

The warranty period for the supply and installation of signs shall be 2 years. All materials shall meet the requirements of Section 54.3.5 - Acceptance Criteria, for the entire warranty period.

The warranty period for the supply and installation of steel pipe sign supports, concrete bases, banding signs, reinforcing girts, cluster frames, and wind frames shall be 1 year.

There is no warranty period for the removal of signs.



54.4 PAINTING STEEL POSTS AND FRAMES AND SIGN STRUCTURES

54.4.1 GENERAL

The Work consists of painting of steel posts and frames and overhead steel sign structures to protect non-galvanized surfaces.

54.4.2 MATERIALS

The Contractor shall supply an aluminum rust resistant paint, or zinc rich paint acceptable to the Engineer. Zinc rich paints shall be used on galvanized posts, frames or structures. The Contractor shall supply tarps and spray sheets when necessary.

54.4.3 PROCEDURE

The Contractor shall remove all flaking rust or peeling paint from the area to be treated. Remaining paint edges or badly pitted areas shall be prepared to a smooth surface prior to painting.

Prior to painting, the surface to be treated shall be dry and clean. Paint shall be applied by spraying, brushing, rolling or a combination of these methods. Plaques on each overhead steel sign structure, stating its file number, shall not be painted.

All bolts, rivets, plate edges, crevices and corners shall receive complete coverage.

The Contractor shall take precautionary measures to prevent property or environmental damage while painting or removing paint. This may include rescheduling spraying operations to light traffic and/or light wind periods, the use of protective devices such as tarps or spray sheets, or whatever other arrangements may be necessary to prevent paint drift.

The Contractor shall conform to all environmental protection requirements for Painting work, as may be specified in the Department's Environment Protection Guidelines.

54.4.4 ACCEPTANCE CRITERIA

Evaluation of the Work will be based upon a visual inspection by the Engineer. To be acceptable, flaking or peeling paint must be removed prior to the painting, there must be a complete coverage of paint, and the work site is left in a clean condition.

54.4.5 MEASUREMENT AND PAYMENT

The work will be measured as a lump sum item.

Payment for Painting Steel Posts and Frames and Sign Structures will be made at the unit price bid for the lump sum item: "Painting Steel Posts and Frames" or "Painting Sign Structures". This payment will be full compensation for preparing the surface, supplying and applying the paint, site cleanup, public and environmental protection, and all labour, material, equipment, tools and incidentals necessary to complete the Work.

54.4.6 WARRANTY

The warranty period for this Work shall be 1 year.

If rust is evident under the new layer of paint within the warranty period, the Contractor shall clean and repaint these areas to the satisfaction of the Engineer, at the Contractor's cost.



54.5 ROAD EDGE GUIDE POSTS

54.5.1 GENERAL

The Work consists of the supply and installation of flexible guidepost traffic delineators, the removal and disposal of existing guideposts and the removal and reinstallation of existing guideposts.

54.5.2 STANDARDS

AS /NZS 1906	Retroreflective Materials and Devices for Road Traffic Control Purposes.
PNGS 1151	Manual of Uniform Traffic Control Devices.
PNGS 1152	Road Signs - Specifications.
PNGS 1498	Methods of Testing Concrete.

54.5.3 MATERIALS

The Contractor shall supply guideposts in accordance with the Contract and the Department of Works Drawing A3/90007. Alternative supply of Guide Posts shall be in accordance with the relevant Australian Standards and subject to the Engineer's approval.

Posts to conform to the following:

Material:	Non-structural Grade Pine or equivalent, subject to Engineer's approval
Colour:	White.
Finish:	Smooth, glossy.
Dimensions:	1350mm x 100mm x 50mm, dimensions to be constant to within 1 mm.

Class 1 Retroreflective material sheeting, dimensions: 50mm x 50mm, shall be securely attached 100 mm from the top of the post and shall be visible to oncoming traffic, colour red facing traffic on left and colour white facing traffic on right.

The lower 600mm portion of wooden Guide Post shall be treated with 3 coats of Creosote, with 3 hours drying time between Creosote coats. Equivalent wood preservative may be used, subject to Engineer's approval. Follow manufacturer's application recommendations for other equivalent wood preservative. The top end of the Guide Post shall have a 30° slope from the horizontal across its 50 mm depth. The upper 900 mm portion of wooden Guide Post shall be painted with 1 coat of white undercoat and 1 coat of white enamel, no less than 48 hours after application of final Creosote coat or equivalent preservative treatment.

The surface of the post shall be smooth and free from irregularities or defects, the surface of the post shall not be affected by cleaning using scrapers, detergent and water, or solvent. The performance of the posts shall not be affected by ozone, exhaust fumes, asphalt or road oils, dirt, vegetation, or any other types of air contamination or materials likely to be encountered after installation.

54.5.4 PROCEDURE

The Contractor shall be responsible for location and marking of underground utilities prior to excavation.

The Contractor shall supply and install guideposts plumb and vertical throughout their length, at a uniform height in accordance with drawings A3/90007, at locations identified by the Engineer and spacings specified. In some cases, the Engineer will identify that existing guideposts shall be removed and reinstalled at a different spacing.

The applicable colour of high-intensity reflectorized sheeting shall be installed and the work area shall be restored to its original condition.



54.5.5 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection by the Engineer. To be acceptable, the guide posts shall possess the specified material characteristics, shall be installed in accordance with the applicable drawings and the work site shall be left in a neat and tidy condition.

54.5.6 MEASUREMENT AND PAYMENT

Measurement will be made of the number of guideposts supplied and installed, removed or removed and reinstalled.

Payment will be made at the unit price bid per guidepost for "Wooden Guidepost - Supply and Install." This payment will be full compensation for supply of the guideposts, removal and disposal of existing posts when necessary, installation of the new posts, and all labour, material, equipment, tools and incidentals necessary to complete the Work.

Payment will be made at the unit price bid per guidepost for "Wooden Guidepost - Remove and Dispose". This payment will be full compensation for the removal and disposal of the guidepost(s) and all labour, material, equipment, tools and incidentals necessary to complete the Work.

Payment will be made at the unit price bid per guidepost for "Wooden Guidepost - Remove and Reinstall". This payment will be full compensation for the removal and reinstallation of the guidepost(s) and all labour, material, equipment, tools and incidentals necessary to complete the Work.

54.5.7 WARRANTY

There warranty period for this Work is 1 year.



54.6 REMOVE AND DISPOSE OF GUARDRAIL, CABLE BARRIER AND POSTS

54.6.1 GENERAL

The Work consists of permanently removing and disposing of guardrail or cable barrier and posts. This specification only applies when guardrail or cable barrier is not being replaced.

54.6.2 MATERIALS

The Contractor shall supply suitable material for backfilling of holes.

Unless otherwise specified by the Contract, the Contractor shall assume ownership of all guardrail materials.

54.6.3 PROCEDURE

The Contractor shall remove and dispose of guardrail and posts and/or cable barrier and posts as directed by the Contract.

Holes shall be backfilled and compacted with material suitable to the Engineer and all excess debris (build up of sand) under the guardrail shall be removed and the site restored to match existing side slopes.

54.6.4 ACCEPTANCE CRITERIA

Evaluation of the Work will be based upon a visual inspection by the Engineer. The Work will be considered acceptable when the site has been left in a neat and tidy condition, all materials have been removed from the site, and the side slopes are satisfactorily restored.

54.6.5 MEASUREMENT AND PAYMENT

Measurement will be made in metres of the length of guardrail and/or barrier removed.

Payment will be made at the unit price bid per metre for "Guardrail/Barrier - Remove and Dispose". This payment will be full compensation for the removal and disposal of guardrail and/or barrier materials, removal and disposal of the posts, supplying backfill material and backfilling holes, cleanup of the disturbed areas, and all labour, equipment, tools and incidentals necessary to complete the Work. Such payment will only be made in situations when the guardrail or cable barrier is not being replaced.

54.6.6 WARRANTY

The warranty period for this Work is 60 days.

Settlement greater than 50 mm in disturbed areas occurring during the warranty period shall be repaired at the Contractor's expense.



54.7 SUPPLY AND INSTALLATION, REALIGN OR RESET W-BEAM GUARDRAIL AND POSTS

54.7.1 GENERAL

The Work consists of supplying and installing W-Beam guardrail and posts, wing ends and bridge connectors for use as hazard avoidance barriers. The Work also consists of replacing posts only, replacing steel w-beam only and realigning or resetting guardrail.

54.7.2 STANDARDS

Conform to the following Standards and Publication unless specified otherwise:

PNGS 1151	Manual of Uniform Traffic Control Devices.
PNGS 1498	Methods of Testing Concrete.
AS /NZS 1111	ISO Metric Hexagon Commercial Bolts and Screws.
AS /NZS 1112	ISO Metric Hexagon Nuts, Including Thin Nuts, Slotted Nuts and Castle Nuts.
AS /NZS 1580	Paints and Related Materials - Methods of Test.
AS 1604	Timber – Preservative Treated – Sawn and Round.
AS /NZS 1906	Retroreflective Materials and Devices for Road Traffic Control Purposes.
AS/NZS 4680	Hot Dip Galvanized (Zinc) Coatings on Fabricated Ferrous Articles.
AS 4025.1	Paints for Equipment Including Ships - Solvent - Borne - Interior and Exterior - Full Gloss Enamel.

54.7.3 MATERIALS

The Contractor shall use W-beam guardrails equivalent to “Armco Flex Beam Guardrail” (nominal 300mm width) or similar formed from HA 350 steel. The Rails shall be capable of withstanding a cold bend of 180° around a diameter 2.5 times its own thickness without cracking. Metal thickness to be 2.7mm minimum.

Terminal sections shall be formed from HA 350 steel having the same properties and thickness as the rails.

If posts and spacer blocks are not provided by the rail manufacturer, they shall be fabricated from steel channel sections in accordance with the Department’s Standard Drawing: A3/90259.

Length of bolts to be sufficient to extend 6mm to 12mm beyond nuts.

All metal components shall be hot dip galvanized after fabrication, to AS 4680. All observed defective galvanizing shall be repaired by painting with a zinc rich paint of similar colour to the Engineer’s approval, at the Contractor’s expense.

If specified in the Contract, the Contractor shall supply wooden guardrail posts in accordance with Clause 8.2.2 of the Department’s Specification for Roads and Bridges, August 1995.

The Contractor shall supply fender posts in accordance with the Department’s Standard Drawing SB.10A. – Fender Post Detail.

The Contractor shall provide evidence to the Engineer that the material provided meets the specified characteristics.



54.7.4 PROCEDURES

54.7.4.1 Installing Guardrail

Standard installations shall be in accordance with the manufacturer's recommendations and or drawing A3/90259. Installations at bridge approaches shall be in accordance with drawing SB.10A, and construction shall always be started at the bridge.

Posts shall be accurately set to the required depth and alignment in a smooth, continuous installation, as shown in the drawings or as directed by the Engineer. Permissible tolerance for plumb and grade of posts shall be as shown on the applicable drawings. Short irregularities (generally less than 30 metres long) in the paved surface should not affect the curve of the completed rail. In order to avoid trapping the wheels, there can be no more than a 175 mm gap between the edge of pavement and the face of the rail.

Posts shall be installed to minimize settlement or "lean" over time. Excavated material which is unsuitable for use as backfill shall be substituted with granular material by the Contractor at his expense. Backfill shall be thoroughly compacted using mechanical tampers, in layers not exceeding 150 mm, for the full depth of the excavation. Cementitious materials shall not be used for post support unless specifically authorized by the Engineer.

Fender posts shall be installed in accordance with the Department's Standard Drawing SB.10A.

Erect the guard rails in a manner that produces a smooth, continuous, taut rail closely conforming to the line and grade of the roadway.

Guardrail laps shall be in the direction of traffic flow. Attach reflective delineators to the guardrail in accordance with the Manufacturer's specifications.

Bolts shall be tightened with hand tools to approximately a torque of 100 N·m. Shape bolt shoulders and holes in rail elements to prevent the bolts from turning.

The Contractor shall take all necessary precautions to eliminate damage to galvanizing. Minor abrasions shall be repaired by painting with two coats of zinc-rich paint. Major abrasions shall be repaired by regalvanizing. The Contractor, at his own cost, shall carry out the repair or replace components to the satisfaction of the Engineer.

Surplus excavated material and debris shall be removed from the site and disposed of by the Contractor at his expense.

When performing guardrail repairs, the Contractor shall check the adjoining posts for splitting, rotting or other damage and report these to the Engineer.

Installations facing traffic shall not be left unfinished and open-ended when the work site is unoccupied, unless protected as detailed in the Traffic Accommodation in Work Zone manual.

The Contractor shall stamp newly installed guardrail posts with the date of installation as directed by the Engineer. The site of the date stamping shall be coated with an approved preservative material when the continuity of the original treatment is compromised.

54.7.4.2 Realigning Guardrail

Work to move guardrail posts back into alignment without having to disassemble the guardrail beam or remove the post(s) from the soil is considered realigning.

54.7.4.3 Resetting Guardrail

Work to restore alignment that involves disassembly of the guardrail beam and removing posts from the ground is considered resetting. (The beam is disassembled when a complete section or more of beam is removed from the posts at each end; splices may or may not be broken during disassembly). Resetting involves removal of the guardrail sections, removal of the existing posts, reinstalling existing posts wherever possible, supply and installation of new posts when required, reinstallation of the guardrail sections and restoration of the alignment and elevation of the rail.



54.7.5 ACCEPTANCE CRITERIA

The Work will be considered acceptable when the reflectors are installed properly, the rail is correctly lapped and within 20 mm tolerance for plumb and grade, the galvanized integrity of the rail has been preserved, the correct date stamps are on the post and rail, posts are installed square to the rail, the face of the guardrail is either inline with or less than 175mm from the outside of the pavement edge, the work site is left in a clean condition and excess spoil removed.

Hot dip galvanized coating shall be smooth, free of beading or sharp projections at edges. Coating adherence shall prevent the peeling of any portion of the zinc coating so as to expose the base metal by cutting or prying with a stout knife under considerable pressure (bond check).

Warped or otherwise deformed rails and terminal elements will be rejected, as will those with injurious defects or excessive roughness of the zinc coating.

The Engineer may verify the penetration and retention of the preservative in wooden posts and blocks by the assay method.

If the guardrail appears to be out of tolerance for plumb or grade, measurements of the height of the guardrail will be made with a tape measure on the section out of tolerance, or using a two-foot hand level for plumb.

Fender posts shall be correctly located, plumb, is of the specified steel section, length and painted as specified in drawing SB.10A. The Engineer's inspection and approval shall be obtained prior to the backfilling of the fender foundation.

54.7.6 MEASUREMENT AND PAYMENT

54.23.6.1 General

Measurement will be made of the number of posts supplied and installed.

Measurement will be made of the number of each item of end terminals, curved W-beam rail, brackets, wing ends, bridge connections and spacer blocks for post systems, supplied.

Measurement will be in metres of the length of W-Beam guardrail installed, realigned or reset.

When the Contractor performs a combination of resetting and "supply and install" work on the same guardrail installation, the appropriate unit price will be paid for the two different types of work.

54.7.6.2 W-Beam and Elements

Payment for installing guardrail will be made at the unit price bid per metre for "W-Beam Guardrail-Supply and Install". This payment will be full compensation for removal and disposal of existing guardrail, supplying and installing all required straight W-Beam guardrail sections restoration of the initial alignment of the guardrail, , and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

The supply of end terminals, curved W-beam rail, brackets, wing ends, bridge connections, and spacer blocks for post system shall be paid at the unit price bid price per item, for "W-beam End Terminals – Supply" or "W-Beam spacer blocks for post systems – Supply" or "Curved W-beam rail – Supply" or "W-beam brackets – Supply" or "W-beam wing ends – Supply" or "W-beam bridge connections – supply".

Payment for the installation of the beam section elements will be made at the unit price bid per metre for "W-beam Guardrail - Supply and Install". Payment for the installation of the brackets, spacer blocks and other required hardware will be considered incidental to the Work.

54.7.6.3 Guardrail Posts

Payment for supplying and installing new posts will be made at the applicable unit price bid per post for "Guardrail Posts 1.750 m Wooden - Supply and Install", "Guardrail Posts 1.8 m Metal - Supply and Install" or "Guardrail Posts Plastic - Supply and Install" or Fender Post – Supply and Install". Payment will be full



compensation for removing and disposing of existing posts, supplying and installing the new posts, detaching and re-attaching of the w-beam (centre bolt), restoration of the initial alignment of the guardrail, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

54.7.6.4 Fender Posts

Payment for supplying and installing new fender posts will be made at the applicable unit price bid per post for "Fender Post – Supply and Install". Payment will be full compensation for removing and disposing of existing fender posts, supplying and installing the new fender posts, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

54.7.6.5 Realigning

Payment for realigning existing guardrail will be made at the unit price bid per metre for "W-Beam Guardrail - Realigning". This payment will be full compensation for straightening the guardrail sections, re-plumbing and tamping the posts, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

54.7.6.6 Resetting

Payment for resetting existing guardrail will be made at the unit price bid per metre for "W-Beam Guardrail - Resetting". This payment will be full compensation for removal of the guardrail sections, removal of the existing posts, reinstallation of the existing posts where applicable, reinstallation of the guardrail sections, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

Payment for the supply and installation of new posts will be made at the applicable unit price bid per post for "Guardrail Posts - Supply and Install" for the specified length.

54.7.7 WARRANTY

The warranty period for supplying and installing guardrail shall be 1 year. The warranty period for realigning and resetting guardrail is 90 days.



54.8 CLEANING DRAINS

54.8.1 GENERAL

The Work consists of the removal of silt or debris from open and covered drainage structures, including gully pits, junction boxes and cut-off drains, to restore proper drainage.

Drainage structure refers to both lined and unlined drains. The cutting of grass and other vegetation in unlined drains shall be carried out in accordance with Specification 54.1: Roadside Vegetation Control.

54.8.2 EQUIPMENT

The Contractor shall supply all equipment and tools necessary to complete the Work.

The use of water tanker, vacuum truck or heavy lift equipment is normal to this activity.

54.8.3 PROCEDURES

The Contractor shall erect the necessary temporary signage and apply traffic control measures, in accordance with the Department of Works Safety Guidelines.

The Contractor shall remove and dispose of material from the drainage structures specified in the contract. Do not deposit any debris where it can be washed back into the drain.

When the debris has been removed from the drains, the entire drains, including the drain inverts, shall be free of debris, allowing a normal flow of water. Debris is defined as silt, rock, other granular material, obstructive wood or vegetative material, road kill, metal and plastic objects, packaging materials, household items and other non-granular materials.

54.8.4 ACCEPTANCE CRITERIA

All the drainage structures specified in the Contract shall be free of debris, allowing a normal flow of water as determined by the Engineer. The Cleared debris is disposed of at an approved disposal site. Removable grates and drain covers are correctly restored.

54.8.5 MEASUREMENT AND PAYMENT

54.8.5.1 General

When debris is cleaned from the drain, removing and disposing of that debris to an approved disposal site from the sloped ends shall be incidental to the Work.

The cleaning of gully pits, junction boxes, and the like, is incidental to this activity and shall be included in the payments for the cleaning of open and covered drains.

54.8.5.2 Cleaning Open Drains

Measurement will be made in metres of the length of open roadside drains and open cut-off drains, cleaned.

Payment will be made at the unit price bid per metre for "Cleaning Open Drains". This payment will be full compensation for removing and disposing of debris from the drain to an approved disposal site, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.



54.8.5.3 Cleaning Covered Drains

Measurement will be made in metres of the length of covered drains, cleaned.

Payment will be made at the unit price bid per metre for "Cleaning Covered Drains". This payment will be full compensation for removing and disposing of debris from the drain to an approved disposal site, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

54.8.6 WARRANTY

There is no warranty period for this Work.



54.9 MAINTENANCE OF DRAINS

54.9.1 GENERAL

This section specifies the maintenance of roadside drains including: Table Drains, Table Drain Offlets, Table Drain Blocks, Stop Berms, Catch Drains.

54.9.2 EQUIPMENT

The Contractor shall supply all equipment and tools necessary to complete the Work.

The use of compactors, graders, loaders, excavators, dump trucks or heavy lift equipment is normal to this activity.

54.9.3 PROCEDURES

54.9.3.1 Table Drains

Construct or rehabilitate and trim to the dimensions shown on the drawings.

Remove all obstructions including dead trees, fallen branches and regrowth.

Grade to prevent ponding of water.

Discharge into culverts, offlet drains or watercourses.

54.9.3.2 Table Drain Offlets

Construct or rehabilitate and trim to the shape of a trapezoidal or v-drain with maximum batter slope 2:1 horizontal to vertical.

Divert table drains into offlet drains at intervals not exceeding 150 metres, or as specified.

Remove all obstructions including dead trees, fallen branches and regrowth.

Extend drains as far as required to prevent water ponding in the table drains, with length to be minimum 50m.

Ensure the capacity of the offlet is not less than the capacity of the table drain, and is of similar cross section and dimensions.

Align and grade the offlet so that the water drains away without scour and damage, and to disperse water as sheet flow or into natural watercourses, at a gradient not to exceed 1.5%.

Divert the table drain offlet drain neatly around natural obstacles such as large rocks and trees.

54.9.3.3 Table Drain Blocks

Construct or rehabilitate and trim table drain blocks at offlets.

Construct blocks from standard fill conforming to the following requirements:

Plasticity Index:	6% minimum.
Length:	To extend from edge of shoulder to top of outer table drain batter.
Width:	3 metre minimum, at the top, measured parallel to the road centre line.
Height:	To edge of shoulders.
Max. Slope:	1(v) : 1.5(h)
Compaction:	Layers not exceeding 250 mm compacted thickness.



54.9.3.4 Stop Berms

Construct or rehabilitate and trim stop berms at locations diverting the flow from table drains into a stream or culvert.

Construct berms from standard fill conforming to the following requirements:

Plasticity Index:	6% minimum.
Height:	To edge of shoulders.
Max. Slope:	1(v) : 1.5(h)
Compaction:	Layers not exceeding 250 mm compacted thickness.

54.9.3.5 Catch Drains

Construct or rehabilitate and trim catch drains. Carry out prior to formation, subgrade, and other drainage works.

Depth:	500 mm (minimum) into solid ground.
Gradients:	Ensure free flow, prevent ponding of water, prevent scour.
Outlets:	As terrain permits construct at frequent intervals to reduce scour. Construct a block on continuous grades to divert water into culverts or drains.
Offset:	2 m (minimum) and 4 m (maximum) beyond the edge of the cutting.

Divert the drain neatly around large rocks and trees.

54.9.4 ACCEPTANCE CRITERIA

Constructed or rehabilitated and trimmed drains shall have a clean and neat appearance with uniform sides and inverts, to the satisfaction of the Engineer.

Maintained drains shall be free of debris, allowing a normal flow of water as determined by the Engineer.

The cleared debris and waste material is dispose of at an approved disposal site.

Removable grates and drain covers are correctly restored.

Drain inverts shall have a maximum 75mm variance above or below the specified level, free of depressions capable of ponding water.

54.9.5 MEASUREMENT AND PAYMENT

54.9.5.1 Table Drains

Measurement will be made in kilometres of the length of table drain constructed or rehabilitated and trimmed, for one side of road.

Payment will be made at the unit price bid per kilometre for "Maintenance of Table Drains". This payment will be full compensation for construction or rehabilitation and trimming of table drains, removal of waste material and debris from the drain to an approved disposal site, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.



54.9.5.2 Table Drain Offlets

Measurement will be made in metres of the total length of table drain offlets constructed or rehabilitated and trimmed.

Payment will be made at the unit price bid per linear metre for "Maintenance of Table Drain Offlets". This payment will be full compensation for construction or rehabilitation and trimming of table drain offlets, removal of waste material and debris from the drain to an approved disposal site, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

54.9.5.3 Table Drain Blocks

Measurement will be for the number of table drain blocks constructed or rehabilitated and trimmed.

Payment will be made at the unit price bid per table drain block for "Maintenance of Table Drain Blocks". This payment will be full compensation for construction or rehabilitation and trimming of table drain blocks, removing and disposing of waste material and debris from the drain to an approved disposal site, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

54.9.5.4 Stop Berms

Measurement will be for the number of stop berms constructed or rehabilitated and trimmed.

Payment will be made at the unit price bid per stop berm for "Maintenance of Stop Berms". This payment will be full compensation for construction or rehabilitation and trimming of stop berms, removing and disposing of waste material and debris from the drain to an approved disposal site, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

54.9.5.5 Catch Drains

Measurement will be made in metres of the total length of catch drains constructed or rehabilitated and trimmed.

Payment will be made at the unit price bid per linear metre for "Maintenance of Catch Drains". This payment will be full compensation for construction or rehabilitation and trimming of catch drains, removing and disposing of waste material and debris from the drain to an approved disposal site, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

54.9.6 WARRANTY

The warranty period for this Work shall be 6 weeks.



55.0 CROSS-DRAINAGE STRUCTURES MAINTENANCE SPECIFICATIONS

- 55.1 BRIDGE MAINTENANCE
- 55.2 BRIDGE STRUCTURE CLEANING
- 55.6 CLEANING CULVERTS
- 55.8 REMOVAL OF CULVERTS
- 55.9 SUPPLY AND INSTALLATION OF CULVERTS
- 55.10 REPAIR OF CULVERTS



55.1 BRIDGE MAINTENANCE

55.1.1 GENERAL

Bridges include bridge structures, round culverts with diameter greater than 1500 mm, or elliptical culverts with capacity equal to or greater than that of a 1500 mm diameter round culvert. In addition, several smaller culverts (in the same watercourse) which together provide capacity greater than that of a 1500 mm diameter round culvert may also be considered a "bridge" or "Cross Drainage Structures – CDS".

In general, the current Department of Works (DoW) Specifications for Road and Bridge Works, applicable Papua New Guinea and Australian Standards and DoW standard and specific Bridge Drawings, and Bridge Manufacturer’s Drawings and Materials Specifications will apply to the Work.

Generally, routine minor repair and maintenance of bridges will be of an amount no greater than K100,000 per site, and will consist of but not be limited to the following:

55.1.1.1 Bridge Structures

- joint repair (cover plates/seals)
- resetting bearings
- touch-up painting
- backwall sheeting
- corbel/cap replacement
- wheelguard repair
- subdeck replacement
- temporary abutment and pier support
- retrofit drain installations
- concrete sealer application
- repair of wing sheeting, piling
- accident damage repair
- repair/replacement of structural steel members
- repair/replace strip-deck
- deck patching (epoxy polymers, silica fume, etc.)
- approach slab repairs
- concrete patching
- epoxy injections
- galvanizing handrail

55.1.1.2 Culverts

<ul style="list-style-type: none"> • culvert strutting • bulkheads • culvert extensions • pressure grouting • reinforced concrete floor repair and installation • headwalls 	<ul style="list-style-type: none"> • shot-crete repairs • concrete collar repair and replacement • "partial" tunnel liners
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55.1.1.3 Waterway

- drift removal
- rip-rap replacement and installation (with associated geo-textile fabric and Gabion repairs and installation)
- minor headslope restoration



55.1.2 MATERIALS

Materials incorporated into the Work shall conform to the DoW Specification for Road and Bridge Works, the Papua New Guinea Standards, relevant Australian Standards, or American Society for Testing and Materials (ASTM) and other standards approved by the Department of Works.

All waste materials shall be disposed of in a manner acceptable to the Engineer. Upon the request of the Engineer, the Contractor shall provide a written acceptance from the receiver of any disposed of materials.

55.1.3 PROCEDURE

55.1.3.1 Construction Safety

Comply with the provisions of the Industrial Safety, Health and Welfare Act, the Environment Act 2000, Department of Works Safety and Environment Protection Guidelines.

Provide essential safety equipment, protective clothing and devices, and first aid facilities.

Maintain all plant and safety equipment in safe working order.

Comply with applicable Papua New Guinea and Australian Standards.

Thoroughly instruct all employees in the hazards of their work and how to avoid injury.

Ensure that good safety practices are observed throughout the Contract.

Inform the Engineer promptly of any accident or injury of a serious nature occurring to any person at the site of the works.

Appropriate Traffic Control signs shall be erected when required at the specified locations in accordance with the DoW Specification for Road and Bridge Works and Safety Guidelines. Appropriate warning signs for approaching traffic, shall be erected at all times while the works is in progress.

55.1.3.2 Safety Helmets

Provide safety helmets for all employees working in or about the construction site.

Provide sufficient spare helmets at the construction site for issue to visitors.

Ensure that employees wear helmets whilst working on site.

Immediately replace any safety helmet which has been damaged.

Erect signs at each site main entrance with clearly painted or printed words, not less than 75 millimetres in height, having the following English language legend and its equivalent in "Tok Pisin":

- SAFETY HELMET AREA
- HELMETS MUST BE WORN ON THIS SITE

55.1.3.3 Safety Officer

Where specified by the Contract, statutory requirement or the relevant Standard, appoint a responsible Safety Officer who shall be properly instructed as to his duties and be available at all times.

Give the Safety Officer's name and address to the Engineer in writing prior to the commencement of the activity for which such appointment is required.

Immediately replace the Safety Officer with an approved person if the Engineer considers that the Safety Officer failed to discharge his duties in a proper manner.

Provide all required permits and logs.

Make allowance for all plant, labour, and materials and all expenses necessary to provide a Safety Officer and comply with the specified requirements for safety.



55.1.3.4 Erection and Safety Equipment and Construction Plant

Ensure that all tackle, safety harnesses and gear, scaffolding, staging, ladders, winding arrangements, plant, and other appliances used in the works satisfy the requirements of the Industrial Safety, Health and Welfare Act, relevant PNG and Australian Standards, and current requirements of all relevant statutory regulations dealing with erection equipment and plant.

Remove all non-conforming appliances from the works.

Assume full responsibility should any accident occur, even if the Engineer approved the Contractor's equipment and plant.

55.1.4 ACCEPTANCE SAMPLING AND TESTING

The Contractor is responsible for quality control on workmanship and materials incorporated into the Work, and shall, unless otherwise directed by the Engineer, perform quality assurance checks, inspections and acceptance of fabricated materials in accordance with:

- the Department of Works Specification for Road and Bridge Works;
- applicable Standard and specific Bridge Drawings;
- bridge materials specifications provided by approved bridge materials manufacturers;
- applicable Papua New Guinea and Australian Standards or other Department approved standards;

55.1.5 MEASUREMENT AND PAYMENT

The Contractor will complete all requested work records, such as:

- technical data (i.e. concrete strength reports, pile data, surveys/profiles, etc.);
- pictures, sketches, or drawings;
- bridge inspection reports;
- as-constructed drawings;
- diaries (when required);

Payment shall be on the basis shown on the Contract Special Provisions and the Bill of Quantities for all the completed Work therein described. Where no specific provision is made for progress payments, payment shall be made only upon the Engineer's acceptance of the Work.

55.1.6 WARRANTY

The warranty period shall be as shown on the Contract and shall commence on the date of the final acceptance of the Work, as determined by the Engineer.



55.2 BRIDGE STRUCTURE CLEANING

55.2.1 GENERAL

The Work consists of the removal and disposal of all dirt, debris and deleterious material.

55.2.2 MATERIALS

The Contractor shall supply all materials necessary to complete the Work.

Water used for washing the bridge shall not contain any materials that may be damaging to the bridge structure.

55.2.3 EQUIPMENT

Regardless of the equipment or method chosen, the bridge structure and appurtenances shall not be damaged in any way by the cleaning operation. Any damage caused by the Contractor's operations shall be promptly repaired at his expense.

55.2.4 PERMITS AND APPROVALS

The Contractor shall be responsible for obtaining any permits and approvals required for the supply of water and disposal of dirt and debris prior to commencement of the Work.

55.2.5 PROCEDURES

55.2.5.1 General

When washing overpass structures, the Contractor shall ensure that dirt or debris is not deposited on vehicles or pedestrians passing below.

55.2.5.2 Surfaces To Be Cleaned

The following surfaces shall be cleaned of all dirt, debris and deleterious material and washed with water to remove the remaining chemicals and winter abrasives:

- decks, sidewalks, curbs, gutters and the exterior surfaces of sidewalks or curbs,
- railings and truss members to a minimum height of three metres above the deck surface, including the bottom chord,
- all associated drainage structures, including scuppers, drain troughs, drain pipes and flumes,
- the approaches to the bridge and all associated bridge elements for a distance of ten metres, as measured from the abutment joint, including approach guardrail, and
- expansion joints and deck joints including troughs and seals. Sealed and unsealed joints may require different treatment schedules.

55.2.5.3 Additional Surfaces to Be Cleaned

When required by the Engineer, any or all of the following surfaces shall also be cleaned and washed:

- the entire abutment and the end two metres of the superstructure, as measured from the face of the backwall. The abutment includes the bearings, backwall, breastwall, wingwalls and the abutment seat;
- pier caps and pier bearings, and the end two metres of the superstructure, each way, from the centreline of the pier, and
- the concrete slope protection.



55.2.5.4 Removal of Accumulated Material

The Contractor shall remove from the bridge deck, median, curb and sidewalks, all accumulated dirt and debris and dispose of it prior to washing. Disposal of such material in or near watercourses will only be done with the appropriate permit.

55.2.6 MEASUREMENT AND PAYMENT

Measurement will be in square metres of the bridge deck cleaned, regardless of the type and size of the substructure and superstructure.

Payment will be made at the unit price bid per square metre for "Bridge Structure - Cleaning". This payment will be full compensation for the supply of water including any required permits and approvals, cleaning and washing all surfaces identified in Section 55.3.5.2, disposal of dirt and debris, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

In situations where a roadway lane closure is necessary to clean an overhead structure, traffic accommodation for the lane closure will be paid for in accordance to the Contractor's Traffic Control Plan, as approved by the Engineer.

Payment for cleaning the additional surfaces specified in Section 55.2.5.3, will be made as Extra Work, in accordance with the Dayworks provisions of the Contract.

55.2.7 WARRANTY

There is no warranty period for this Work.



55.6 CLEANING CULVERTS

55.6.1 GENERAL

The Work consists of the removal of silt or debris from culvert barrels and culvert sloped end sections to restore proper drainage. The culvert barrel is the portion of the culvert excluding the sloped ends.

55.6.2 EQUIPMENT

The Contractor shall supply all equipment necessary to complete the Work.

The use of Front-end Loader, Water truck, Vacuum truck or heavy lift equipment are normal to this activity and are not considered as specialized equipment.

55.6.3 PROCEDURES

55.6.3.1 Cleaning Culvert Barrels

The Contractor shall remove and dispose of material from the culvert barrel. When the debris blockage has been removed from the culvert barrel, the entire culvert, including the culvert inverts, shall be free of debris, allowing a normal flow of water. Debris is defined as silt, rock, other granular material, wood, vegetative material, household items and other non-granular materials.

55.6.3.2 Cleaning Sloped Ends

The Contractor shall remove and dispose of material from the culvert ends to restore normal water flow. This will require 1 person with hand tools for a period of up to 1 man-hour of labour.

If the culvert end is blocked by silt, rock or other granular material requiring more than 1 man-hour of labour, the Engineer and the Contractor will determine the appropriate action and the specialized equipment required for cleaning the culvert ends.

55.6.4 ACCEPTANCE CRITERIA

The culvert barrel and/or culvert ends shall be free of debris and silt, rock or granular material, allowing a normal flow of water as determined by the Engineer.

55.6.5 MEASUREMENT AND PAYMENT

55.6.5.1 Culvert Barrels

Measurement will be made in metres of the full length of culvert barrel, for a specific range of diameters, regardless of the size or length of blockage.

Payment will be made at the applicable unit price bid per metre for "Cleaning Culvert Barrel - up to 800 mm diameter," or "Cleaning Culvert Barrel - over 800 mm and less than 1500 mm diameter" and "Cleaning Culvert Barrel - 1500 mm and over". This payment will be full compensation for removing and disposing of debris from the culvert barrel to an approved disposal site, and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

When debris is cleaned from the culvert barrel, removing and disposing of that debris to an approved disposal site from the sloped ends shall be incidental to the Work.

55.6.5.2 Sloped Ends

Measurement will be made of the number of sloped ends cleaned, regardless of the diameter of the pipe.

Payment will be made at the unit price bid per sloped end for "Cleaning Culvert Ends". This payment will be full compensation for removing and disposing of debris from the culvert end, and all labour, material, equipment, tools and incidentals necessary to complete the Work.

Payment for specialized equipment, if required, and as determined by the Engineer and the Contractor will be paid as Extra Work in accordance with the Dayworks provisions of the Contract.



55.6.5.3 Reduced Time to Complete

In urgent situations where the Contractor is required to complete the Work within 2 calendar days of the issuance of the Work Contract, an additional payment will be made at the unit price bid per occurrence for "Culvert Cleaning Premium". This payment will be full compensation for complying with the accelerated scheduling required to complete the Work.

55.6.6 WARRANTY

There is no warranty period for this Work.



55.8 REMOVAL OF CULVERTS

55.8.1 GENERAL

The Work consists of removing existing culverts (less than 1500 mm in diameter), from roadways and approaches and disposing of the culvert material.

55.8.2 MATERIALS

All culvert materials removed shall become the property of the Contractor.

55.8.3 PROCEDURES

When removal and disposal of existing culverts is required, the Contractor shall dispose of the culvert material at a suitable location, approved by the Department of Works, the Provincial Government and or the Local Level Government. Disposal of culvert material within the right-of-way will not be permitted.

55.8.4 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection by the Engineer. To be acceptable, the Work must conform with the following:

- there is no settlement of the area backfilled;
- the culvert is properly disposed of; and
- the surrounding ditch/area is landscaped to the satisfaction of the Engineer.

55.8.5 MEASUREMENT AND PAYMENT

55.8.5.1 Removal and Disposal of Culverts

Measurement will be made in metres of the total length of pipe removed, including sloped ends.

Payment will be made at the unit price bid per metre for "Culverts - Remove and Dispose". This payment will be full compensation for the removal and disposal of the culvert material, and all labour, equipment, tools and incidentals necessary to complete the Work.

55.8.5.2 Excavation for Removal of Culverts

Measurement will be made in cubic metres of the volume of the excavation required to remove the culvert (less the volume of the culvert).

Payment will be made at the unit price bid per cubic metre for "Culverts - Excavation and Backfill". This payment will be full compensation for excavating and salvaging or disposing of the excavated materials and backfilling the new culvert or excavation with salvaged or new material. If new material is required for backfill, the Contractor shall supply such material suitable to the Engineer. Payment for the supply and haul of new backfill material will be made as Extra Work in accordance with Specifications 53.2 – Pit-run Gravel or 53.3 – Granular Basecourse.

55.8.5.3 Reduced Time to Complete

In urgent situations where the Contractor is required to complete the Work within 14 calendar days of the issuance of the Work Order, an additional payment will be made at the unit price bid per occurrence for "Culvert Removal Premium". This payment will be full compensation for complying with the accelerated scheduling required to complete the Work. If the culvert removal is performed in conjunction with the installation of a new culvert under Specification 54.9, Supply and Installation of Culverts, only one of the "premium" payments will be paid. (Culvert Installation - Premium or Culvert Removal - Premium)



55.8.5.4 Traffic Control for Centreline Culverts

When a highway centre-line culvert is removed, a supplemental payment will be made at the unit price bid per metre of pipe removed for "Centre-line Culvert - Traffic Control". This payment will be full compensation for the additional traffic control involved in removing the culvert.

55.8.6 WARRANTY

There is no warranty period for this Work.



55.9 SUPPLY AND INSTALLATION OF CULVERTS

55.9.1 GENERAL

The Work consists of excavating existing material to proper elevation and installing new or salvaged less than or equal to 1500mm diameter culverts of various types, including preparing the culvert base and placing granular and/or soil backfill.

55.9.2 STANDARDS

Conform to the following Standards and Publications unless specified otherwise:

AS 1012	Methods of Testing Concrete.
AS 1141	Methods for Sampling and Testing Aggregates.
AS 1289	Methods of Testing Soil for Engineering Purposes.
AS 1379	Specification and Supply of Concrete.
AS 1478	Chemical Admixtures for Concrete.
AS 1597	Precast Reinforced Concrete Box Culverts.
AS 1761	Helical Lock Seam Corrugated Steel Pipes.
AS 1762	Helical Lock Seam Corrugated Steel Pipes - Design and Installation.
AS/NZS 2041	Buried Corrugated Metal Structures.
AS 2349	Method of Sampling Portland and Blended Cements.
AS 2350	Methods of Testing Portland and Blended Cements.
AS 2439	Perforated Plastics Drainage and Effluent Pipe and Fittings.
AS 2758.1	Aggregates and Rock for Engineering Purposes - Concrete Aggregates.
AS 3600	Concrete Structures.
AS 3610	Formwork for Concrete.
AS 3706	Geotextiles - Methods of Test.
AS 3725	Loads on Buried Concrete Pipes.
AS 3972	Portland and Blended Cements.
AS 4058	Precast Concrete Pipes (pressure and non-pressure).
AS/NZS 4671	Steel Reinforcing Materials
NTCA	Materials Testing Manual.
AUSTROADS	Bridge Code.
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
ASTM F2306/F2306M-05:	Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.



55.9.3 MATERIALS

When installing new culverts, the Contractor shall supply the new culvert material in accordance with the Department of Works standard drawings or work specific drawings, or with the culvert manufacturer's drawings and specifications, when specified. The Department of Works will determine the type, size, wall thickness and required coatings for the culvert.

Conformance testing will be the responsibility of the Contractor.

Ensure that all pipes and box culverts are indelibly marked with a Standards Australia conformance stamp.

Pipes and box culverts not stamped shall be removed from site at the Contractor's expense.

55.9.3.1 Precast Reinforced Concrete Pipes

Conform with AS 4058. Pipes to be flush joint type with external rubber bands.

Pipes to be clearly marked as to their class.

55.9.3.2 Precast Reinforced Concrete Box Culverts

Use box culverts of the inverted U type suitable for installation on a cast-in-situ concrete slab.

Design and supply box culverts which have a span not greater than 1200 mm, height not more than 900 mm and a fill height not more than 1600 mm in accordance with AS 1597.1.

Design all other box culverts in accordance with AS 1597.2.

55.9.3.4 Corrugated Steel Pipes, Pipe Arches and Arches

Conform to AS 2041. Supply in accordance with the details specified.

Assemble in accordance with the manufacturer's instructions.

55.9.3.5 Corrugated Polyethylene Pipes

Conform to ASTM F2306/F2306M-05. Supply in accordance with the details specified.

Assemble in accordance with the manufacturer's instructions.

55.9.3.6 Bedding

A clean granular material free from sticks, stones and other deleterious material with a Plasticity Index less than 6, conforming to the table MATERIAL SIZE.

Table - Material Size

AS SIEVE (mm)	PERCENTAGE PASSING BY DRY MASS
19.0	100
2.36	50 – 100
0.60	20 – 90
0.30	10 – 60
0.15	0 – 25
0.075	0 – 10

55.9.3.7 Concrete

Conform to the requirements of Group 14 of the Department of Works Specification for Road and Bridge Works, 2015.



55.9.3.8 Mortar

Use one part fresh cement and three parts clean sharp sand mixed with potable water to yield a stiff but workable mixture.

55.9.3.9 Select Fill

Conform to the requirements of Specification 53.1: Excavation and Backfill or Specification 53.2: Pit-Run Gravel.

55.9.4 PROCEDURES

55.9.4.1 Excavation and Preparation of Base

Excavation for the culvert base shall be to a depth of not less than 0.3 m below the culvert invert elevation, as established by the Engineer, and shall be of sufficient width to permit assembly of the pipe and the operation of compaction equipment on either side of the pipe. All soft, yielding, or unsuitable material at this level shall be removed to a depth as directed by the Engineer and replaced with granular or other acceptable material to provide a firm foundation of uniform density throughout the entire length of the pipe.

On completion of excavation for the culvert base and the removal and replacement of any soft, yielding or unsuitable material, the Contractor shall compact the exposed surface to a uniform density. The Contractor shall then construct and thoroughly compact the culvert bed to the established elevation using granular or other material acceptable to the Engineer. The width of the culvert bed shall be 3 times the culvert diameter.

When the culvert installation is in rock, excavation for the culvert base shall be carried out to a depth of not less than 0.2 m below the invert grade. The width of the culvert bed shall be a minimum of 1.5 times the diameter of the pipe.

55.9.4.2 Installation

55.9.4.2.1 General

The culvert shall be installed on the prepared base, true to the elevations lines and grades established by the Engineer. Separate sections shall be securely joined together in accordance with the manufacturer's specifications. Coupler bands shall be used for metal and polyethylene pipe.

The Contractor shall use due care when installing pipe to avoid damaging the pipe. Damaged pipe shall be removed and replaced by the Contractor at his expense.

55.9.4.2.2 Installation of Corrugated Metal Pipe and Pipe Arches

Conform to AS 2041. When required, elbows shall be installed to accommodate sharp changes in gradient or direction of the pipe. Pipe shall be carefully handled to prevent damage to the protective coating. Any damage to coatings shall be repaired by the Contractor at his own expense in accordance with AS 2041 and the manufacturer's specifications and instructions, where required.

55.9.4.2.3 Installation of Corrugated Polyethylene Pipe

Conform to ASTM D 2321. Using a template, the Contractor shall shape the culvert bed to the curvature of the pipe to a depth of 75 mm.

Blocking shall not be used to bring the pipe to grade. Temporary hold-downs shall be used to maintain the position of the pipe during installation.

Sections of pipe with a minimum length of 6 m shall be used on each end of each culvert.

55.9.4.2.4 Installation of Downdrains

When required, downdrain pipes or troughing shall be installed as shown in the drawings, at the locations shown or as designated by the Engineer. A trench shall be excavated to the established depth and grade required for the installation of the downdrain pipe or troughing and any connecting elbows, and its bottom



surface shall provide a uniform, firm foundation throughout the length of the installation, with sufficient width to permit satisfactory jointing and thorough compaction of the backfill material around the pipe.

The installation of all downdrains shall include Flume Dissipaters as detailed in contract specific drawings, the Department of Works Standard Drawing: A1/45022A, or as may be specified by the Engineer.

55.9.4.2.5 Extension of Existing Culverts

Extensions to existing culverts will be considered new installations. Where an existing culvert is to be extended, the removal, salvage and reinstallation of the existing sloped end sections may be required, as shown in the drawings or as directed by the Engineer.

Where the existing pipe was manufactured to imperial dimensions and the new pipe is manufactured to metric dimensions resulting in a mismatch at the joint, the Contractor shall couple and caulk the joint with oakum to obtain a secure joint.

55.9.4.3 Backfilling

55.9.4.3.1 General

Backfill under the haunches and immediately adjacent to the pipe, extending from the culvert base up to an elevation of 30 percent of the vertical height of the pipe, shall be comprised of select granular or soil material, as directed by the Engineer. Backfill immediately adjacent to the pipe above this level shall be comprised of select soil material. All backfill material shall be free of lumps and organic material. Backfill within 300 mm of the pipe wall shall be free of stones larger than 80 mm in diameter.

All backfill material shall be placed in layers not exceeding 0.15 m in depth. Each layer shall be thoroughly compacted at optimum moisture content by means of pneumatic or other mechanical tamping equipment. Backfill and compaction layers shall be brought up simultaneously and evenly on both sides of the pipe, filling all corrugations and ensuring firm contact with the entire bottom surface of the pipe. This compaction procedure shall be continued until the backfill reaches a minimum elevation of 0.3 m above the top of the pipe, or greater if necessary to carry the weight of construction equipment without damage to the pipe.

Backfilling of the remainder of the culvert excavation, beyond the immediate region of the pipe, shall be carried out in accordance with applicable specifications.

55.9.4.3.2 Backfilling Corrugated Polyethylene Pipe

Conform to ASTM D 2321. The minimum height of fill above the top of the pipe shall be 0.6 m.

When saw cutting of sloped ends is required by the Engineer, it shall be performed immediately after backfill is completed.

55.9.5 ACCEPTANCE CRITERIA

To be acceptable, the Work shall comply with the following:

- Drainage through the culvert is in the correct direction;
- There is no observable damage or deformation to the culvert, headwalls and aprons;
- The surface is left at design slope, with no excess spoil. The work area is cleaned up to remove obstructions and prevent erosion damage;
- Backfill is properly compacted so that there will be no significant settling;
- Surplus pieces of culvert are removed from the worksite.



55.9.6 MEASUREMENT AND PAYMENT

55.9.6.1 Supply and Installation of Culverts

Measurement will be made in metres of the total length of pipe supplied and installed, including elbows and end sections.

Payment will be made at the applicable unit price bid per metre for "Supply of Culvert" and for "Installation of Culvert", for the type and size of culvert specified. This payment will be full compensation for supplying, delivering to site and installing the culvert/pipe required by the Contract, and all labour, equipment, tools and incidentals necessary to complete the Work.

55.9.6.2 Excavation and Backfill for Installation of Culverts

Measurement will be in cubic metres of the volume of the excavation required to install the culvert. If an existing culvert is being removed, the volume of the existing pipe will be subtracted from the volume of the excavation.

Payment will be made at the unit price bid per cubic metre for "Culverts - Excavation and Backfill". This payment will be full compensation for excavating to the extent necessary to install the culvert, salvaging or disposing of the excavated material and backfilling the installed culvert with salvaged or new material.

If new material is required for backfill, the Contractor shall supply such material suitable to the Engineer. Payment for the supply and haul of new backfill material will be made as Extra Work in accordance with the Dayworks provisions of the Contract.

55.9.6.3 Culverts For Major Roadways

Culverts across primary highways and major intersecting roadways require a culvert base and structural backfill. Payment for the culvert base and structural backfill will be made in accordance with **Specification 53.2, Pit-Run, or Specification 53.3, Granular Base Course**. Asphalt concrete pavement material required to restore the structure shall be supplied and paid for in accordance with **Specification 53.26, Asphalt Pavement Surface Maintenance**.

55.9.6.4 Reduced Time to Complete

In urgent situations where the Contractor is required to complete the Work within 14 calendar days of the issuance of the Contract, an additional payment will be made at the unit price bid per occurrence for "Culvert Installation - Premium". This payment will be full compensation for complying with the accelerated scheduling required to complete the Work. If the culvert installation is performed in conjunction with the removal of a culvert under Specification 55.8, Removal of Culverts, only one of the "premium" payments will be paid. (Culvert Installation Premium or Culvert Removal - Premium)

55.9.6.5 Traffic Control for Centreline Culverts

When a highway centreline culvert is installed, a supplemental payment will be made at the unit price per metre of pipe installed for "Centreline Culvert - Traffic Control". This payment will be a full compensation for the additional traffic control involved to install the culvert.

55.9.7 WARRANTY

The warranty period for this Work shall be 1 year. If, during the warranty period, the backfilled area has settlement to the extent that it becomes a hazard to the public, the Work shall be repaired at the Contractors cost.



55.10 REPAIR CULVERT ENDS

55.10.1 GENERAL

The Work consists of excavating material from the culvert end to allow reconnection or realignment of the culvert end, or reconstruction of the culvert bed and replacement of the rip-rap, or bending, cutting or otherwise reshaping the exposed culvert material to reinstate, as much as possible, the original shape.

55.10.2 MATERIALS

The Contractor shall supply oakum, couplers, additional rip-rap when necessary.

55.10.3 EQUIPMENT

The extent of the repair work required for each pipe will dictate whether hand tools or larger equipment are necessary.

55.10.4 PROCEDURES

Existing rip-rap material shall be removed and salvaged where applicable.

When the pipe end is distorted and no excavation is required, the culvert end can be reshaped to its original intended shape, by the use of hand tools.

When the repair to the culvert end requires reconnecting and/or realigning of the culvert end and/or reconstruction of the culvert bed and/or replacement of the existing rip-rap, excavation may be required. Reshaping of the pipe end may also be required as part of this Work.

Oakum may be required to provide a seal when reconnecting a culvert end.

55.10.5 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection by the Engineer. To be acceptable, culvert ends must be properly connected, aligned and shaped. Rip-rap shall be reinstalled to the satisfaction of the Engineer and the culvert end shall allow normal drainage.

55.10.6 MEASUREMENT AND PAYMENT

Separate measurement will be made of the number of culvert ends repaired by hand tools and of the number of culvert ends repaired by equipment.

Payment will be made at the unit price bid per culvert end for "**Culvert End Repair - Using Hand Tools**". This payment will be full compensation for reshaping the culvert end, and all labour, hand tools and incidentals necessary to complete the Work.

Payment will be made at the unit price bid per culvert end for "**Culvert End Repair - Using Equipment**". This payment will be full compensation for removing, salvaging and reinstalling rip-rap where applicable, excavating around the culvert end, rebuilding the culvert bed as required, reshaping the culvert end, realigning and reattaching the culvert end as required, and all labour, equipment, tools, including hand tools and incidentals necessary to complete the Work.

Payment for couplers, oakum and additional rip-rap, when required will be made as Daywork materials in accordance with the Daywork provisions of the contract.

55.10.7 WARRANTY

There is no warranty period for this Work.



56.0 MISCELLANEOUS SPECIFICATIONS

- 56.2 HAULING
- 56.31 SUPPLY OF ARROWBOARDS FOR TRAFFIC CONTROL
- 56.32 SUPPLY OF FLAGPERSONS FOR EMERGENCY TRAFFIC CONTROL



56.2 HAULING

56.2.1 GENERAL

The Work consists of loading subgrade soil, granular materials or asphalt mixtures to trucks and the transporting of these materials from the point of loading to a designated delivery location.

Where the application of conversion factors is necessary, the conversion factors detailed in the Special Provisions shall be used unless other factors are determined on site by the Engineer from actual weight and dimension measurements and volume calculations.

56.2.2 MATERIALS

The Contractor shall supply all materials required for initial conditioning, dust control, maintaining, and restoring the approved haul routes, as described herein.

56.2.3 PROCEDURE

56.2.3.1 Haul Restrictions

The Engineer may restrict or disallow hauling altogether when excessive damage occurs to highways or public roads; and when hauling operations create a hazard or are too difficult to contend with for other users of the roadway.

The conditions under which this may apply include but shall not be limited to the following:

- during or after a heavy rainfall, or
- during periods of exceptionally high traffic flows.

The Contractor shall abide by all load restrictions established for the local roads and bridges.

56.2.3.2 Haul Route Inspection and Approval

A haul road is a route over which materials are hauled for the performance of the Contract.

Prior to commencement of haul, haul roads shall be inspected by authorized representatives of the Provincial Government, the Contractor, and the Engineer to establish and record the general existing conditions. Upon completion of haul, the Contractor shall restore the road to a condition equivalent to or better than that which existed at the time haul commenced.

Another inspection shall then be carried out by authorized representatives of the Provincial Government, the Contractor, and the Engineer. The Engineer shall be the final authority in assuring the restoration required.

The Contractor shall inform the Engineer of the location of his prospective aggregate and asphalt pavement patching material sources and individual haul routes prior to commencement of the Work. The Contractor shall be responsible for obtaining authority to haul over the proposed haul routes from the Provincial agency having jurisdiction. The use of National highways as haul routes is subject to the approval of the Engineer.

The Contractor shall initially condition, maintain and restore haul routes to the agreed condition of the Provincial agency having jurisdiction, and in the case of nationally owned or controlled roads to the satisfaction of the Engineer.

The Contractor shall be responsible for the new construction, initial conditioning, maintenance, dust control and restoration of public and private roads required for his haul.



56.2.3.3 Calculation and Approval of Haul Distance

The haul distance shall be the measured distance in kilometres and tenths of a kilometre along the designated route between the point of loading and the designated delivery point. The designated delivery point shall be considered as the centre of the project kilometre, except:

- if a section is shorter than one kilometre, the designated delivery point shall be the centre of that section;
- if a dead haul road splits a project kilometre into two sections, the designated delivery point shall be the centre of each section;

If in the opinion of the Engineer, a material haul distance is excessive when compared to the known distances of other sources of the same material, then the Engineer will set a maximum allowable haul distance for which payment will be made.

56.2.4 MEASUREMENT AND PAYMENT

56.2.4.1 Haul

When payment for haul in tonne-kilometres or cubic metre-kilometres is specified, the haul distance will be measured in kilometres and tenths of a kilometre along the designated route between the point of loading and the designated delivery point.

Payment for haul will include the cost of loading the material into the trucks.

No payment will be made for hauling to stockpiles where the source and the stockpiles are located within the boundary of the site where the aggregate is being processed.

The quantity of haul will be calculated to the nearest one-tenth of a unit by multiplying the weight or volume of the material by the haul distance for each kilometre or section of a kilometre. The weight or volume will be measured as specified under the specification for the material hauled and payment will be made at the applicable unit price bid per tonne-kilometre or cubic metre-kilometre for "Haul - tonne kilometre" or "Haul - cubic metre kilometre".

56.2.4.2 Haul Roads

In cases where the Engineer designates both the material source and the haul road to be used, all costs associated with new construction, initial conditioning, control of dust, maintenance, and the final restoration of haul roads will be paid for as "Haul Road Establishment and Maintenance Works" in the Bill of Quantities. In all other cases, these costs shall be considered incidental to the Work and will not be paid for separately.

56.2.5 WARRANTY

There is no warranty period for this Work.



56.31 SUPPLY OF ARROWBOARDS FOR TRAFFIC CONTROL

56.31.1 GENERAL

The Work consists of supplying a mobile truck with mounted arrowboard, or a truck with mounted arrowboard parked on site, or a stationary tow-behind arrowboard for controlling traffic in emergency situations

In unique situations, such as cleaning overhead signs or winging inside shoulders on divided highways, an arrowboard may be ordered by the Engineer.

Arrowboards may also be required as part of the normal traffic accommodation for an activity, as specified in the **Department's Safe Traffic Control at Road Works – Field Guide**

56.31.2 EQUIPMENT

The Contractor shall supply all equipment necessary to complete the Work. The arrowboard trucks shall be equipped with the following:

- A truck-to-truck voice communication device.
- An overhead revolving beacon with an amber lens a minimum of 180 mm high and 180 mm wide, or other equivalent type beacon approved by the Engineer. The beacon shall be mounted on the vehicle fully visible to traffic approaching from both front and rear.
- The arrowboard shall be controlled from a console located in the vehicle cab.
- The arrowboard display shall be visible to traffic approaching the rear of the trucks.

All arrowboards shall meet the following specifications:

- Minimum size 0.75 metres x 1.52 metres.
- Minimum of 25 amber sealed-beam hooded lamps.
- Fully adjustable light intensity on all arrowboard lights.
- Operating modes which include:
 - (1) sequential left arrow or chevron
 - (2) sequential right arrow or chevron
 - (3) sequential double arrow or chevron
 - (4) horizontal bar
 - (5) all 4 lamps in the extreme corners of the panel flashing simultaneously at 3550 flashes per minute with the flashing lights lit for 50% of the time.

A light bar is not considered an arrowboard.

56.31.3 PROCEDURES

Unless otherwise specified, the Engineer shall notify the Contractor of the location where arrowboards are required.

On any sites where arrowboards are required, the Contractor shall refer to the **Department's Safe Traffic Control at Road Works – Field Guide** for arrowboard positioning.

A stationary working arrowboard truck shall have its steering wheels turned towards the adjacent ditch.

Messages displayed shall be one of the following:



- On a 2 Lane Highway, 4 flashing corner lights or a bar.
- On a 4 Lane Highway, a right arrow when operating in the left lane and a left arrow when operating in the right lane.
- On a single lane road, 4 flashing corner lights or a bar.

56.31.4 MEASUREMENT AND PAYMENT

Measurement will be in hours (to the nearest ¼ hour) for the time spent transporting the arrowboard to and from the worksite and for the time the arrowboard engaged in the Work in accordance with the following:

- the maximum allowable travel time from the nearest base to the worksite will be one hour
- the maximum allowable travel time from the worksite to the nearest base will be one hour
- travel time shall be reported separately on a daily crew worksheet.
- two 15 minute coffee breaks per day for the operator of a mobile truck mounted arrowboard will be allowed (no deduction)

Payment will be made at the applicable unit price bid per hour for "Supply of Truck Mounted Arrowboard Mobile" or "Supply of Truck Mounted Arrowboard - Stationary", or "Supply of Pull-Behind Arrowboard Stationary". This payment shall be full compensation for supplying and maintaining a truck mounted arrowboard or a pull behind arrowboard and additional transport equipment including and operator where applicable, travel time to and from worksite and all labour, equipment, tools and incidentals necessary to complete the Work.

In situations where the arrowboard is part of the traffic accommodation requirements for a particular activity (as may be detailed in the Department's Safety Guidelines for Road and Bridge Works or the specifications), all costs associated with the supply and use of an arrowboard will be considered incidental to the Work and will not be paid for separately.

56.31.5 WARRANTY

There is no warranty period for this work.



56.32 SUPPLY OF FLAGPERSONS FOR EMERGENCY TRAFFIC CONTROL

56.32.1 GENERAL

The Work consists of providing certified flagpersons, signs, traffic cones and vehicles for controlling traffic in emergency or unique situations as directed by the Engineer. Flagpersons may be required continuously for extended periods of time up to several days.

This specification is not intended to cover the provision of flagpersons which may be required for traffic control as part of typical highway maintenance activities as detailed in the **Department's Safety Guidelines**.

56.32.2 MATERIALS

The Contractor shall supply and maintain the following quantities and types of signs in accordance with the **Department's Safety Guidelines for Road and Bridge Works**:

2 - Lane Flagging

	No.	Sign Number	Description
2	WD-A-41	Road Work	
2	RB-31	Do Not Pass	
2	RD-156	Maximum 50 Passing Workers	
2	WD-A-45	Flagperson	

(Refer to Traffic Accommodation in Work Zones Manual, drawing #TCS-B-2.1A.)

4 - Lane Flagging

	No.	Sign Number	Description
2	WD-A-41	Road Work	
2	RB-5	Maximum Speed Ahead	
2	WD-A-33R or L	Right Lane Ends or Left Lane Ends	
2	RB-31	Do Not Pass	
2	RB-1	Max. Speed	

Additional Warning Signs as Required

2	WD-A-45	Flagperson	
2	RB-1	Maximum Speed (Gazetted)	

(Refer to Traffic Accommodation in Work Zones Manual, drawing #TCS-B-2.1B.)

56.32.3 EQUIPMENT

The Contractor shall supply a vehicle capable of transporting the flagpersons, traffic cones and signs to the site.

56.32.4 PROCEDURES

Flagpersons shall be trained and equipped in accordance with the applicable sections of **the Department's Safety Guidelines for Road and Bridge Works**. The Contractor shall ensure that Flagpersons are instructed in and use proper traffic procedures, appropriate for the prevailing



conditions. Flagpersons shall have proof of certification from a training programme on traffic control procedures through construction zones, recognized by the PNG Road Safety Council. The Engineer reserves the right to accept or reject a Flagperson's certification, if its not from a recognized training programme.

Where there are 2 or more flagpersons working together, each flagperson shall have a 2-way hand-held radio for communication.

The Contractor shall erect the temporary signs as required and maintain, reposition and remove the signs when necessary. The Contractor shall ensure that maintaining signs is performed by someone other than the flagperson.

For short term emergency situations, portable signs may be used. If the emergency signs are required for a period longer than 24 hours, the signs shall be mounted on posts.

56.32.5 MEASUREMENT AND PAYMENT

Measurement will be in hours (to the nearest $\frac{1}{4}$ hour) for the time the signs and vehicle and/or flagperson spend travelling to and from the worksite, loading and unloading signs and are engaged in the Work in accordance with the following:

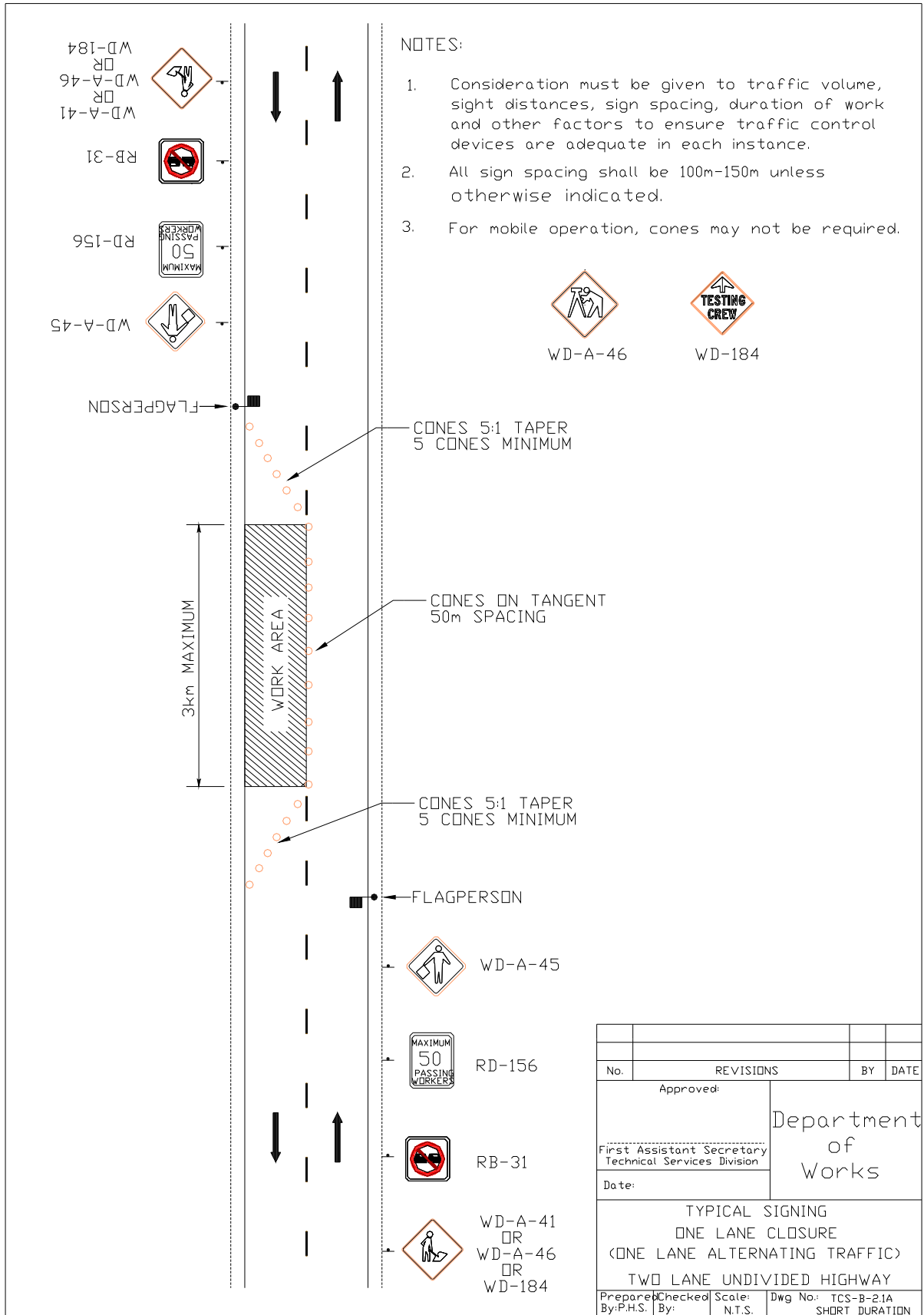
- a minimum of 3 hours, including travel time, per flagperson, per Contract will apply
- loading and unloading signs will be considered 15 minutes each
- the maximum allowable travel time from the nearest base to the worksite will be one hour
- the maximum allowable travel time from the worksite to the nearest base will be one hour
- travel time shall be reported separately on a daily crew worksheet
- travel time will be paid for crew changes at the end of a regular shift
- two 15 minute coffee breaks per day will be allowed (no deduction)

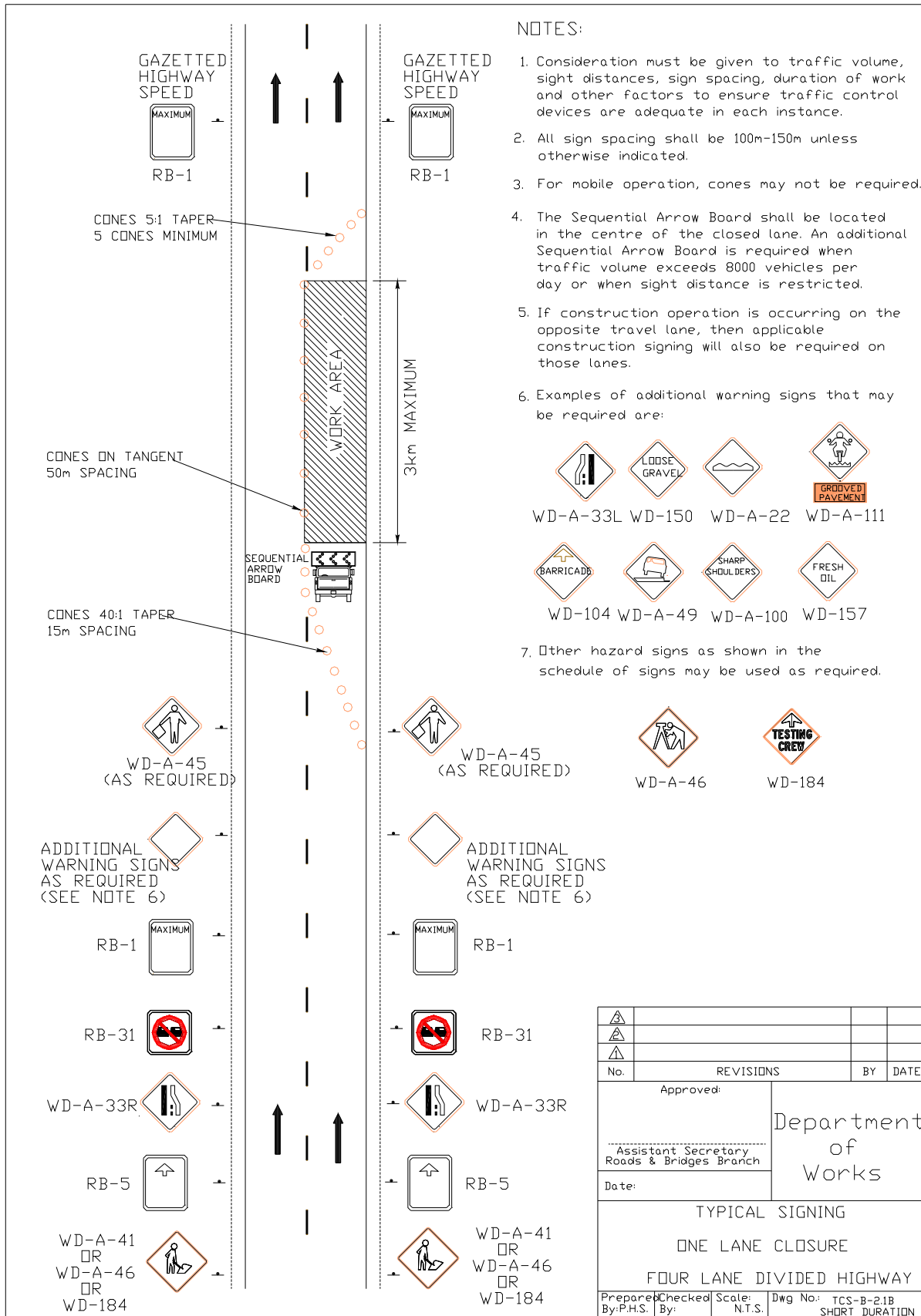
Payment will be made at the unit price bid per hour for "Supply Flagperson, Signs and Vehicle." This payment shall be full compensation for providing a fully equipped flagperson, supplying, erecting, and maintaining all temporary signs, supplying a vehicle, loading and unloading of signs, travel time to and from the site, controlling traffic and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

In cases where only a flagperson is required, payment will be made at the unit price bid per hour for "Supply Flagperson." This payment shall be full compensation for the supply of a fully equipped flagperson, travel time to and from the site, controlling traffic and all labour, material, tools and incidentals necessary to complete the Work.

53.32.6 WARRANTY

There is no warranty period for this work.





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No.	REVISIONS		BY DATE
Approved:		Department of Works	
Assistant Secretary Roads & Bridges Branch			
Date:			
TYPICAL SIGNING ONE LANE CLOSURE FOUR LANE DIVIDED HIGHWAY			
Prepared By: P.H.S.	Checked By:	Scale: N.T.S.	Dwg No: TCS-B-21B SHORT DURATION

Graphics File: TCSB21b.sgn



Pavement Stabilisation Technology