Gravel Roads Maintenance Manual



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Definition of Terms

Asphalt Emulsion: A mixture of asphalt cement, water and an emulsifying agent, which remains liquid until placed on the surface of gravel particles. The emulsion then "breaks" and allows the water to dissipate or evaporate leaving the asphalt to do its job of coating, binding and waterproofing the particles.

Binder: Fines (clay or silt particles), which hold gravel particles together.

Circle: In a grader, the rotary table which supports the blade and regulates its angle.

Crown: The highest point near the centre of a road surface; purpose is to facilitate drainage off the road surface.

Erosion: Wear caused by moving water or wind.

Fines: Clay or silt particles – size of material passing 75 um sieve.

Geotextile: A fabric that is designed for use in soils and gravel, which is used separation to keep manufactured granular materials such a base and subbase, from being contaminated by fine subgrade materials. It allows moisture to flow through it while keeping differing materials separated

Gravel: A mix of stone, sand and fine-sized particles used as sub-base, base or surfacing on a road. In some regions, it may be defined as aggregate.

Limestone Subbase: Crushed limestone, that is usually coarser in gradation than gravel, used to structurally fill an excavated area as a replacement material for a poor quality subgrade. Normally, gravel or base is placed over the subgrade.

Subgrade: The soil that is the base or foundation support material for a roadway or embankment. It may be naturally occurring at the location or may have been hauled in, especial where a fill is required. Once the subgrade is compacted, either gravel or subbase is place over the subgrade for structural improvement.

Washboard: Series of small ridges and potholes that appear in a pattern similar to the surface of a washboard or corrugated cardboard. It is caused by water erosion, vehicle braking and start-off.

Summary of Gravel Road Policy Statements

1. Existing unimproved rights-of-way shall be constructed to an all-weather granular surface and financed as a local improvement. For those properties, which are zoned agricultural, the maximum accessible frontage for any single property shall be limited to 300 feet, as provided under Section 370(1) and 383(1) of The City of Winnipeg Act.

2. Granular surface roadways constructed as a local improvement be maintained at the cost of the City-at-large for a period not in excess of three years from the date of completion of construction.

3. Beyond the three years referred to in Clause (2), the City will carry out only those works necessary to keep the roadway passable. These works consist of basic grading only and will not keep the roadway in a condition comparable to that after completion of the local improvement. Restoration of the roadway to the original local improvement construction standard (continuous application of granular material and dust palliative treatment) would only be done at the expense of the fronting owners as a new improvement.

4. Provide, in the Local Improvement By-Law No. 98/72, for the assessment, as a Local Improvement, the cost of placing gravel and crushed stone on existing gravel surface roadways.

5. One dust palliative treatment to be applied on all gravel lanes and/or streets on the perimeter boundaries of City-owned recreation fields, parks and playgrounds.

6. A one-inch thick gravel application to be carried out approximately every two or three years if required on gravel roads in agriculturally zoned areas.

7. Two dust palliative treatments per annum to be applied to all gravel roads serving residential and agricultural properties of a collector street type.

8. Two dust palliative treatments per year to be applied to all gravel roads used as bus routes by the City of Winnipeg Transit System.

9. A yearly application of a dust palliative on rural gravel roadways, 50 feet either side and in front of those residential properties not already receiving such service.

10. Establish unimproved roadways inside the Urban Limit Line as designated by Plan Winnipeg, that have adjoining lands that have R1 Zoning be maintained to a road oiling Type II level of service carried out every three to five years as required.

Local Improvement (By-Law 98/72)

The By-Law as it pertains to gravel roads (granular surface and surface treated roadways) includes:

1. Granular surfaced roadways, being graded and graveled roadways of at least twenty-four (24) feet in width from shoulder to shoulder, with side ditches and culverts, including two (2) applications of granular material to total the equivalent of six (6) inches in thickness and twenty (20) feet in width as follows:

    a. An initial loose application of granular material to be applied with the grading improvements in the first stage,

    b. A compacted application of granular material and a dust palliative, such as calcium chloride, to be applied in the second stage,

    c. Oiled surface roadways, being existing graded and graveled roadways subject to an additional one inch of compacted granular material, with two (2) applications of compacted sand at the maximum rate of at least one-quarter (1/4) gallon per square yard per application, and two (2) applications of compacted sand at the maximum rate of one ton of sand per 150 square yards with each application of road oil, all to a width of at least twenty (20) feet,

    d. Asphalt surface roadways, being existing oiled surface roadways subject to an application of two (2) inches of asphalt in thickness to a width of at least twenty (20) feet, and the application of granular material to the shoulders of the roadway, and

    e. An application of gravel or crushed stone on existing graded and graveled roadways as may be authorized.

2. Graveled lanes, being lanes subject to two (2) applications of granular material to total the equivalent of at least six inches in thickness to a width of at least twelve (12) feet in two stages, the second lift to be compacted and subject to the application of a dust palliative such as calcium chloride.

    That shall be levied against the real property benefited thereby, shall be the cost of such roadways or lanes at a uniform rate per square yard throughout the City a s determined each year by the Council.

    2a. Provided, however, that granular surfaced roadways shall be maintained, for a period of three years from the date of completion of the construction of same as a local improvement, at the cost of the City at large, after which time the maintenance work shall consist of grading only.

3. Any improvement that may be deemed to be desirable to the roadway on a street or lane, other than those standards defined in this Section 6, may be authorized and the full costs of such improvements thereof may be levied against the real property benefiting thereby.

4. Notwithstanding any other provision herein, the levy for granular surface roadways, and for the gravelling of existing granular roadways in respect to properties zoned agricultural shall be assessed at a maximum frontage of three hundred (300) feet fro any single property holding. If the frontage of any single property holding fronting a graded and graveled roadway exceeds three hundred (300) feet the excess shall be exempt and the cost the graded and graveled roadway fronting on such potion of land shall be borne by the City at large.

Spring Weight Restrictions (By-Law 4068/85)

A By-law to amend The City of Winnipeg Traffic By-law.

Section 17 of By-law No. 1573/77 is repealed and the following substituted therefore:

> "The Commissioner shall place and maintain or cause to be placed and maintained temporary traffic control devices to limit the weights of vehicles operated upon streets and roads that do not have concrete pavements, to a maximum gross weight of any axle assembly for each centimetre of width of tires on the wheels of the axle assembly of 60 kilograms, for a period of up to 90 days during the periods of the year when damage to such streets and roads would otherwise reasonably be expected to occur. The Director of Operations shall keep and maintain a current list setting out the streets and sections of streets to which spring weight restrictions apply."



Recent changes to the Provincial Legislation of Spring Weight restrictions change the allowable weight to 90% of normal axle loading and defines fixed dates at which spring weight will implemented (March 23) and at which the restrictions will be removed (May 31). Restrictions may be removed as early as May 24 if field conditions warrant.

Drainage

1.0 Description

1.0 Road Surface

Road surface drainage is the prevention or elimination of standing water on the road surface by maintaining a proper crown and cross-fall and directly the water to the roadside ditch. Good surface drainage is the most critical short-term measure of maintaining a longer lasting gravel road surface. In short, we want to get the water off the road.



1.1 Ditch

Ditch drainage is the flow of water (or the prevention or elimination of standing water) in a roadside ditch to another ditch, culvert, inlet, creek or river without erosion of the drainage assets. Proper ditch drainage will contribute, in the long term, to maintaining a consistent gravel road capable of carrying normal loads and traffic volumes for gravel roadways. In short, we want to keep the water away from the road.



2.0 Benefits

A gravel roadway with proper surface drainage will be easier to maintain with reduced blading and material losses as a result of fewer potholes and less washboarding. This can lead to significant direct cost savings. In addition, a smoother road surface may result in fewer accidents and less vehicle damage.

Any roadway, whether its gravel or paved, will benefit from having a proper ditch drainage. Drainage is the fundamental engineering starting point to any road project. Long term standing water is detrimental to performance of the roadway. Roads with standing water in the ditches may exhibit soft spots and weakness of the subgrade. Standing water may be absorbed into the subgrade soil resulting in lower than typical load bearing capacities and a higher potential for frost boils in the spring, which are very costly to repair. As a result of proper drainage, the public receives a more consistent level of service from the roadway and the City will spend less money maintaining gravel roads.

3.0 Procedure

3.1 Surface drainage

Refer to the section on maintaining the crown in Dragging Gravel Roads or in Shaping and Preparing Gravel Roads.

3.2 Ditch drainage

3.1.1 A survey should be obtained from the Engineering Division to ensure that proper drainage is achievable.

3.1.2 If achievable, design grades should be set and ditch cleanout provided, using excavator and trucks.

3.1.3 If not achievable, refer the roadway to the Administration so that the issue of poor drainage can be taken up with the Water & Waste Department.

4.0 Scheduling

4.1 Surface drainage correction should be scheduled with the routine dragging.

4.2 Ditch drainage improvements on roads that are to receive a chip sealing should be done at least one (1) year in advance. On regular gravel roads, ditch drainage can be done at anytime prior to winter, but preferably during the summer months.

Subgrade Repair / Stabilization

1.0 Description

Subgrade repair and stabilization is required on roads with soft areas or severe frost boils. The repair involves the removal of the unstable material and replacing it with granular base material. The road subgrade material may be unstable due to high moisture content, due to being a frost susceptible material (or a material that is conducive to frost boils) or a combination of both. The permanent remedy is the replacement of the unstable material with better quality material. A key in the prevention of frost boils is the provision of proper drainage.

2.0 Benefits

A gravel roadway with soft spots or frost boils can be very dangerous for the motoring public in that a roadway can appear to be safe for normal traveling speed when it may not be safe due to sporadic soft spots or frost boils. The provision of roadway with a consistent surface will result in safer roads, which result in fewer accidents and less damages.

3.0 Material:

An approved geotextile (refer to Approved Products List in Standard Construction Specifications)
100 mm Limestone Subbase
50 mm Limestone Subbase
20 mm Traffic Gravel

4.0 Equipment:

Excavator
Tandem trucks, as required.
Compactor – recommend padfoot or sheepsfoot for subgrade (clay)
Motor grader – recommend smooth dream vibratory for granular materials
Signing and barricades

5.0 Procedure

5.1 Prior to any excavation, it is mandatory to obtain underground clearances from all utility companies. Damaging a utility line is not only costly to repair, but also may be extremely dangerous in the case of electrical or gas lines.
5.2 Excavate the unstable area to a minimum of 1.0 m depth or to solid clay subgrade is encountered (length and width of repair is site specific; should extend beyond the limits of the failure).
5.3 Place geotextile along the sides and bottom of the excavation. Overlap any joints by a minimum of 600 mm.
5.4 Place and compact 100 mm size limestone subbase to minimum thickness of 600 mm.
5.5 Place and compact 50 mm size limestone subbase to within 75 mm of final surface grade.
5.6 Place and compact 75 mm thickness of traffic gravel/base.

6.0 Scheduling

6.1 Schedule repairs as soon as possible after reported.
6.2 Investigate if ditch drainage improvements are required and schedule accordingly.

Dragging Gravel Roads

1.0 Description



The dragging of gravel roads is the routine maintenance of a gravel road to keep the traveling surface relatively smooth and consistent. This treatment should be used to keep in check the development of surface irregularities such as rutting, raveling, potholes and loose gravel. It also helps to keep positive drainage for the road surface by maintaining the crown and crossfall. The length of effectiveness of this treatment is dependant on weather conditions and traffic volume and type.

2.0 Benefits

The benefits of conducting this treatment include the provision of relatively smooth gravel road surface on which traffic can safely drive the posted speed. Maintaining the surface will result in fewer accidents and reduced vehicle damage. As well, maintaining the surface will increase the interval before major reshaping may be required.

3.0 Materials

None, normally.

4.0 Equipment

Motor grader equipped with “stinger” blades.

5.0 Procedure

5.1 Lightly scarify surface to the depth and width necessary.
5.2 Spread material uniformly across the travelling surface
5.3 Maintain a crowned roadway surface with a 4% crossfall (1/2 inch drop per foot of width).
5.4 Ensure that all material is distributed uniformly across the roadway. Do not leave small windrows of surplus material at the shoulder edge.

Roadway should be crowned to provide proper drainage. The surface should be relatively free of potholes and washboard and tight. The traffic gravel should be well mixed with little segregation of coarse material.

6.0 Scheduling

6.1 It is recommended that the dragging of gravel roadways be conducted any time the surface condition begins to deteriorate and when there is excess loose gravel between the wheel paths. The frequency of dragging will depend on the weather, traffic volume and type of vehicles as well as the overall condition of the roadway.

6.2 It recommended that road surfaces be dragged when there is a combination of sufficient moisture content and loose gravel. Routine dragging should not be carried out in dry weather as it may lead to loss of crown, loose gravel and rapid deterioration of the overall road condition.

6.3 Dragging must be carried right up to freeze up to ensure the roadway is in the best condition possible for the winter.

6.4 Additional traffic gravel will be required when there is insufficient good granular material to properly reshape the surface or if the existing surface material contains in excess of 30% fines or less than 15% fines. (Fines is defined as the % by mass of material passing the 75 µm sieve.)

Dragging Gravel Shoulders

1.0 Description

The dragging of gravel shoulders the reshaping of gravel shoulders along a paved street. This treatment eliminates shoulder drop-off and provides positive drainage from the pavement and shoulder surface by maintaining the shape and surface of the shoulder. The treatment also controls vegetation and re-establishes the shoulder line. The length of effectiveness of this treatment is dependant on weather conditions and traffic volume and type.



2.0 Benefits

The benefits of conducting this treatment include the provision of smooth transition and surface on which traffic has place to pull safely onto, vegetation control and drainage; all of which result in a safer and longer lasting roadway for the public.

3.0 Materials

3.1 Traffic Gravel
Additional traffic gravel, as required.

4.0 Equipment

4.1 Motor grader or an approved shoulder-shaping machine (use of 2 graders would increase production.
4.2 Tractor towing set of wobbly tired rollers, if required.
4.3 Water truck, only if extremely dry conditions exist.

5.0 Procedure

5.1 Pull material up from the outside of the shoulder using care not to contaminate the gravel material with sod or mud.
5.2 If required, add new traffic gravel.
5.3 Shape the shoulder to provide a level surface at the pavement edge and a 4% crossfall (1/2 inch drop per foot of shoulder width).
5.4 Compact the gravel shoulder, as required.
5.5 Final surface at pavement edge should not be higher than the pavement or roll curb, so water can drain across the pavement and shoulder and traffic using the shoulder has a smooth transition.

6.0 Scheduling

6.1 It is recommended that the reshaping of gravel shoulders be conducted in early spring and again in the fall to properly maintain the shape. Depending on conditions more frequent shaping may be required.
6.2 Additional traffic gravel may be required when there is insufficient good material to reshape the surface or if the existing material contains in excess of 30% fines or too much mud, sod or other debris. Consideration would have to be to wasting some of the existing material.

Shaping and Preparing Gravel Roads

1.0 Description



The shaping of gravel roads is the scarifying and reworking of the road surface from shoulder edge to shoulder edge to provide a relatively smooth and consistent traveling surface. This treatment should eliminate "washboard" conditions, rutting, raveling, potholes and loose gravel. It also provides positive drainage for the road surface by restoring the crown and crossfall. The proper roadway width and shoulder lines are re-established.

This treatment is also used to prepare gravel roads to receive dust control. The treatment is normally done after the frost in entirely out of the ground. This is typically after the spring weight restrictions are removed near the end of May.

2.0 Benefits

The benefits of conducting this treatment include the restoration of the surface, crown and cross-fall or to bring the roadway up to standard after the winter season. The treatment will provide a relatively smooth gravel road surface which can either be simply maintained by dragging or receive a dust control product as per the policy. Maintaining the road surface will result in fewer accidents and reduced vehicle damage. Proper shaping and preparing will result in gravel roads that are overall easier to maintain throughout the summer and fall.

3.0 Materials

Additional traffic gravel, as required.

4.0 Equipment

Motor grader equipped with "stinger" blades.
Appropriate compaction equipment.

5.0 Procedure

5.1 Scarify surface to the depth and width necessary to reshape the surface and remove all surface defects.
5.2 Pull material up from the outside shoulder edge of the road surface using care not to contaminate the gravel material with sod or mud. If necessary, ensure that vegetation on or near shoulders is cut short. (Gravel pushed off during winter operations may be retrievable.)
5.3 Add new traffic gravel, as required.
5.4 Shape the surface to provide a crowned roadway surface with a 4% crossfall (1/2 inch drop per foot of shoulder width).
5.5 Once properly shaped, compact and tight blade the road surface.
5.6 Maintain the surface with routine dragging.

The finished road should be properly crowned to provide proper drainage and the surface should be free of potholes and washboard and should be tight. The traffic gravel should be well mixed with little segregation of coarse material.

6.0 Scheduling

6.1 It is recommended that the reshaping of gravel roadway surfaces be conducted in late spring and as required thereafter. The frequency of dragging will depend on the weather, traffic volume and type of vehicles as well as the overall condition of the roadway.

6.2 Additional traffic gravel will be required when there is insufficient good granular material to properly reshape the surface or if the existing surface material contains in excess of 30% fines or less than 15% fines. This should be assessed in spring. The addition of gravel must be arranged prior to starting the reshaping.

6.3 If the road is being prepared for dust control, schedule the work such that the dust control follows within a week.

Dust Control

1.0 Description

Dust control is defined as the application of an approved dust control product to a prepared gravel roadway in accordance with the policy. The treatment will provide dust control for an extended period of time dependant on weather conditions and traffic volume and type. The treatment will assist in maintaining the shape and surface of the roadway resulting in a somewhat higher quality of gravel roadway surface than a non-treated roadway.



2.0 Benefits

2.1 Tangible benefits

Tangible benefits of dust control that result in direct savings to the City include reduced blading costs and reduced material loss and regraveling costs.

2.2 Intangible benefits

Intangible benefits of dust control include reduced accidents and vehicle damage, higher quality of life and property values for those living or working adjacent to the treated roadway, reduced cleaning costs, and mitigated dust induced health problems.

3.0 Materials/Products

3.1 Calcium Chloride ($CaCl_2$)

$CaCl_2$ is the most commonly used product for dust control on gravel roadways by various Canadian road and municipal agencies. It performs cost effectively over a wide range of soil subgrade types, traffic volumes and climatic conditions. $CaCl_2$ absorbs moisture form the atmosphere and road surface and forms a thin film of water around the soil/gravel particles, which attracts dust particles and assists in the prevention of the release of dust particles from the road surface to the atmosphere.

$CaCl_2$ should typically be applied in 1 or 2 applications per season at a rate of 1.5 litres per m^2 for the 1^{st} application and a rate of 1.0 litre per m^2 for any subsequent treatments. Surface fines content should be 15 ± 5% for optimal performance.

3.2 Magnesium Chloride ($MgCl_2$)

$MgCl_2$ is also commonly used as a dust control product on gravel roadways. $MgCl_2$ works on the same principle as $CaCl_2$ in controlling dust in that moisture is absorbed from the atmosphere or road surface and forms a thin film of water around the soil/gravel particles, which attracts dust particles and assists in the prevention of the release of dust particles from the road surface to the atmosphere. It also performs cost effectively over a wide range of soil subgrade types, traffic volumes and climatic conditions.

$MgCl_2$ should typically be applied in 1 or 2 applications per season at a rate of 1.5 litres per m^2 for the 1^{st} application and a rate of 1.0 litre per m^2 for any subsequent treatments. Surface fines content should be 15 ± 5% for optimal performance.

3.3 Lignosulphonate

Lignosulphonate is a by-product of the pulp and paper industry. It works on a different principle than $CaCl_2$ or $MgCl_2$ in that it acts as a binder that glues gravel, soil and dust particles together. It is currently not recommended for use on City streets because it only performs well under light traffic conditions & volumes (less than 200 vehicles/day).

3.4 Petroleum Base Products

Various types of emulsified primes have been tried in the past. These products also work on the principle of binding particles together and sealing the roadway surface. These products are generally more costly to use and result in a roadway surface that is difficult to maintain once it begins to get rough.

4.0 Equipment

4.1 City

4.1.1 Motor grader, preferably equipped with “stinger” blades.

4.1.2 Wobbly rollers and tow tractor

4.1.3 Water truck, as required.

4.2 Dust Suppressant Supplier

4.2.1 Distributor with a minimum capacity of 15,000 litres, equipped with a pressurized spray bar with an positive and instant on/off valve capable of spraying 3.0 m in width at a constant and uniform pressure through spray nozzles set to provide a minimum of 50% overlap coverage of the adjacent spray nozzle.

4.2.2 Distributor unit to be equipped with an electronic spray monitor and automatic rate controller system, which is visible and accessible to operator while driving and which is calibrated for the type of material being applied.

5.0 Procedure

5.1 Prepare roadway for dust treatment using details for shaping identified in Section on "Shaping and Preparing Gravel Roads" and adding gravel as required.
5.2 Be careful not to float too much clay to the surface by over watering and over rolling.
5.3 Order dust control product a minimum of 24 hours, preferably 48 hours, prior the date of application.
5.4 Just prior to application of dust control product, lightly roughen surface with a grader.
5.5 Ensure material is in a moist state and if too dry, lightly water.
5.6 Maintain traffic control.
5.7 Apply dust control product uniformly at the specified rate.
5.8 Allow 30 minutes for penetration into the surface.
5.9 Roll the entire surface with wobblies only once in order to seal the surface. Additional rolling has no benefit and may result in bringing too many fines to the surface.

6.0 Monitoring and Maintenance

6.1 Monitor performance of the dust control treatment and condition of the road surface during routine zone inspections.
6.2 If the surface becomes rough, washboard or potholed to a point where a light reshaping is required, perform work when surface is in a moist state. The shaping can easily be done after a light rainfall, or lightly water the surface being starting, if too dry. This will rejuvenate the dust control and make reworking the road surface an easier task, resulting in a better end product.
6.3 Once the dust control product begins to lose its general effectiveness, a second application may be necessary, depending on the time of the year. (If it's late September, an additional treatment may not be warranted).

Chip Seal Program

1.0 Description



Chip Sealing is the application of a thin surface treatment to a gravel roadway, on which base preparation and surface shaping has been completed. The surface treatment consists of small graded aggregate placed on an asphalt emulsion, which has been sprayed on the road surface. The treatment provides an all weather road surface that is sealed/waterproofed, is dust free and has good skid resistance. Although the treatment is expected to last 4 to 6 years, the length of effectiveness is dependant on the subgrade/base strength, weather conditions and traffic volume and type.

2.0 Benefits

The benefits of conducting this treatment include the provision of relatively smooth road surface that will not require blading, shaping or dust control for several years. The treatment will provide a safer, higher level travel surface on a granular roadway that will result in fewer accidents and reduced vehicle damage. The light colour of the chips also generally improves night visibility as more light is reflected.

3.0 Materials

3.1 Subgrade/surface preparation – traffic gravel that meets the requirements of the annual supply specification.

3.2 Chip sealing

- 3.2.1 Chips – seal coat aggregate that that meets the requirements of the specification of the annual supply quotation. *See material gradation specs.*
- 3.2.2 Oil – HF 150S emulsion that meets the requirements of the specification of the annual supply quotation. Apply emulsion at a rate of 1.35 litres per m^2.

4.0 Equipment

4.1 Subgrade/surface preparation

- 4.1.1 Motor grader
- 4.1.2 Pulvi-mixer (Bomag MPH 100 or equivalent)
- 4.1.3 Water truck
- 4.1.4 Rubber tired wobbly rollers pulled by tractor

4.2 Chip sealing
- 4.2.1 Asphalt oil distributor
- 4.2.2 Chip spreader
- 4.2.3 Steel drum roller - vibratory
- 4.2.4 Rubber tired wobbly roller – self-propelled.
- 4.2.5 Tandem trucks (number depends on haul distance for aggregate)
- 4.2.6 Loader
- 4.2.7 Sweeper

5.0 Procedure

5.1 Subgrade/Surface Preparation
- 5.1.1 Evaluate road for uniformity in surface condition and structural condition least one month prior to planned seal coat program.
- 5.1.2 If required, use pulvi-mixer to mix the subgrade uniformly and improve stability. Water and compact to standard.
- 5.1.3 Haul, lay and compact new base course.
- 5.1.4 Shape the surface to provide a crowned roadway surface with a 3% crossfall (3/8 inch drop per foot of shoulder width).
- 5.1.5 Once properly shaped, tight blade the road surface.
- 5.1.6 Final surface should be crowned to provide proper drainage, should be free of potholes and washboard and tight. The base course should be well mixed with little segregation of coarse material.

5.2 Chip sealing
- 5.2.1 Two days prior to planned operation, ensure road surface is free of defects including potholes, raveling, washboard, or soft spots.
- 5.2.2 Perform all necessary repairs.
- 5.2.3 Ensure that the oil distributor and chip spreader are calibrated to appropriate settings.
- 5.2.4 Ensure appropriate level of traffic control is applied.
- 5.2.5 Spray emulsion at specified temperature and rate with distributor (Rate = 1.35 litres per m^2).
- 5.2.6 Spread chips with chip spreader at a uniform thickness to cover the emulsion.
- 5.2.7 Roll the surface with a steel drum roller to embed the chips.
- 5.2.8 Finish roll with rubber tired wobbly rollers.
- 5.2.9 Once the oil has cured, remove excess loose chips with sweeper.
- 5.2.10 Evaluate finished surface.

6.0 Scheduling

Chip sealing is best done in the months July and August when warmer air temperatures allow the oil to cure properly. Allow ample time to schedule preparatory work prior to the seal coat crew arriving.

7.0 Maintenance

Each spring and fall the surface should be evaluated for distresses. Potholes should be filled with cold mix, spray patching or hot mix.

Motor Grader Operating Checklist

General Requirements:

Protective clothing/equipment per department policy:

- Safety footwear
- Hard hat availability
- Hearing, eye, protection as required

Safe Operating Procedures:

- All lights shall be operational and clean.
- Adjust seat and wear seat belt .
- Allow engine to reach operating temperature before using a full load capacity.
- Mounting/dismounting – face machine, use hand holds, steps and ladders.
- Mouldboard shall be raised and locked in place for travel.
- Mouldboard must be lowered to the ground before the operator leaves the motor grader.
- Always check to ensure the way is clear and raise mouldboard and attachments before backing.
- Engine shall be shut down before any repair work is performed.
- Do not operate against traffic (unless within a properly signed work zone).
- During winter operations do not plow against traffic.
- Come to a full stop before changing gears from forward to reverse or vice/versa.
- Disengage clutch and allow transmission to stop spinning before shifting into gear.
- Do not apply park brake when parking after plowing as the brakes may freeze on. The grounded plow and mouldboards will act as a brake.
- At least once an hour check to ensure all lights are working and clean. Do this more often under bad weather conditions. Check for wear or damage to blades and shoes.
- Added caution shall be used when near railway crossings. Attachments or mouldboard shall not make contact with the rails. No snow build-up or other debris shall be left on the rail bed.

Visual:

- Fluid levels
- Belts
- Tires
- Steering linkage
- Glass and mirrors
- Safety chains, pins and guard, hoisting cables
- Lights
- Suspensions
- Blades
- Shoes
- Hydraulics
- Mud flaps (for loose bolts)
- Lubrication

Cab Interior:

- Seat adjustment
- Seat belt
- Mirror adjustment
- Windshield wiper/washer
- First aid ki

CHART I - DEPTH of GRAVEL in mm

		Width of Roadway in metres													
Cubic metres per kilometre	**Tonnes per kilometre**	**3.5**	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**	**9.0**	**9.5**	**10.0**
150	**325**	43	38	33	30	27	25	23	21	20	19	18	17	16	15
200	**450**	57	50	44	40	36	33	31	29	27	25	24	22	21	20
300	**675**	86	75	67	60	55	50	46	43	40	38	35	33	32	30
400	**875**	114	100	89	80	73	67	62	57	53	50	47	44	42	40
500	**1100**	143	125	111	100	91	83	77	71	67	63	59	56	53	50
600	**1325**	171	150	133	120	109	100	92	86	80	75	71	67	63	60
700	**1550**	200	175	156	140	127	117	108	100	93	88	82	78	74	70
900	**1975**	257	225	200	180	164	150	138	129	120	113	106	100	95	90
1000	**2200**	286	250	222	200	182	167	154	143	133	125	118	111	105	100
1100	**2425**	314	275	244	220	200	183	169	157	147	138	129	122	116	110
1200	**2650**	343	300	267	240	218	200	185	171	160	150	141	133	126	120
1300	**2875**	371	325	289	260	236	217	200	186	173	163	153	144	137	130
1400	**3075**	400	350	311	280	255	233	215	200	187	175	165	156	147	140
1500	**3300**	429	375	333	300	273	250	231	214	200	188	176	167	158	150

How to use the Gravel Charts: Charts I & II

1. On Chart I, find the width of road that you will gravelling.
2. Read down the column to the desired depth of gravel that you wish to add.
3. Read across to the left hand columns to determine how cubic metres per kilometre or tonnes per kilometre that you to achieve this depth.
4. From that you can determine the number of cubic metres or tonnes of gravel that you have to order.

5. On Chart II, find the number of cubic metres per kilometre or tonnes per kilometre that you need.
6. At the top of chart find the capacity in cubic metres of the trucks that will be used to haul gravel.
7. Read down the chart to determine how many metres each truck will cover. This is your spread rate.

CHART II - SPREAD RATE CALCULATIONS

Gravel Spreading Chart in metres per Truckload

Truck Capacity in cubic metres

Cubic metres per kilometre	Tonnes per kilometre	3	4	5	6	7	8	9	10	11	12	13	14	15
150	**325**	20	27	33	40	47	53	60	67	73	80	87	93	100
200	**450**	15	20	25	30	35	40	45	50	55	60	65	70	75
300	**675**	10	13	17	20	23	27	30	33	37	40	43	47	50
400	**875**	8	10	13	15	18	20	23	25	28	30	33	35	38
500	**1100**	6	8	10	12	14	16	18	20	22	24	26	28	30
600	**1325**	5	7	8	10	12	13	15	17	18	20	22	23	25
700	**1550**	4	6	7	9	10	11	13	14	16	17	19	20	21
900	**1975**	3	4	6	7	8	9	10	11	12	13	14	16	17
1000	**2200**	3	4	5.0	6.0	7	8	9	10	11	12	13	14	15
1100	**2425**	3	4	4.5	5.5	6.4	7.3	8.2	9.1	10	11	12	13	14
1200	**2650**	3	3	4.2	5.0	5.8	6.7	7.5	8.3	9	10	11	12	13
1300	**2875**	2	3	3.8	4.6	5.4	6.2	6.9	7.7	8.5	9.2	10.0	11	12
1400	**3075**	2	3	3.6	4.3	5.0	5.7	6.4	7.1	7.9	8.6	9.3	10	11
1500	**3300**	2	3	3.3	4.0	4.7	5.3	6.0	6.7	7.3	8.0	8.7	9	10

Example:

A 1.5 kilometre section of 8.0 metre wide roadway needs 50 mm of new gravel.

a) How much gravel needs to be ordered?

b) How far can a truck spread, assuming that the truck capacity is 8.5 cubic metres?

Answer:

a) Using Chart I, under the 8.0 metre road width column, find 50 mm thickness (3rd row down).
Read across chart to find that you need approximately 400 cubic metres per kilometre or 875 tonnes per kilometre.
Therefore, you would order 1.5 x 400 = **600 cubic metres** of gravel for this roadway to achieve a 50 mm thickness.

b) Using Chart II, find the cubic metres per kilometre rate column and go down to 400. Read across the chart and find 20 metres per truckload under 8 cu. metre truck capacity and 23 metres per truckload under the 9 cu. metre truck capacity.
Therefore, using 8.5 cubic metre trucks on 8.0 metre wide roadway, spreading gravel at a thickness of 50 mm,
the length of spread for each truck would be **21.5 metres** (between 20 and 23 metres on the chart).

DUST CONTROL CHART

Litres of Dust Palliative Required to Treat 1000 m or 1 kilometre of Road Surface

	Width of Roadway in metres													
	3.5	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**	**9.0**	**9.5**	**10.0**
Application Rate in Litres per m2														
1.0	3,500	4,000	4,500	5,000	5,500	6,000	6,500	7,000	7,500	8,000	8,500	9,000	9,500	10,000
1.1	3,850	4,400	4,950	5,500	6,050	6,600	7,150	7,700	8,250	8,800	9,350	9,900	10,450	11,000
1.2	4,200	4,800	5,400	6,000	6,600	7,200	7,800	8,400	9,000	9,600	10,200	10,800	11,400	12,000
1.3	4,550	5,200	5,850	6,500	7,150	7,800	8,450	9,100	9,750	10,400	11,050	11,700	12,350	13,000
1.4	4,900	5,600	6,300	7,000	7,700	8,400	9,100	9,800	10,500	11,200	11,900	12,600	13,300	14,000
1.5	5,250	6,000	6,750	7,500	8,250	9,000	9,750	10,500	11,250	12,000	12,750	13,500	14,250	15,000
1.6	5,600	6,400	7,200	8,000	8,800	9,600	10,400	11,200	12,000	12,800	13,600	14,400	15,200	16,000
1.7	5,950	6,800	7,650	8,500	9,350	10,200	11,050	11,900	12,750	13,600	14,450	15,300	16,150	17,000
1.8	6,300	7,200	8,100	9,000	9,900	10,800	11,700	12,600	13,500	14,400	15,300	16,200	17,100	18,000
1.9	6,650	7,600	8,550	9,500	10,450	11,400	12,350	13,300	14,250	15,200	16,150	17,100	18,050	19,000
2.0	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	18,000	19,000	20,000

Example: *a) How many litres of dust palliative should be used to treat 1.5 kilometres of newly treated street that is 7.5 metres wide?*

b) How many litres would be required for subsequent dust control treatments?

Answer:

a) Using the above chart, find width of treatment column at 7.5 m.
Run down column to the row for 1.5 litres per m2 (recommended rate for a new treatment).
Reading from the chart, 11,250 litres will be required to treat a 1000 metre length.
Therefore, 1.5 x 11250 = 16,875 litres should to initially dust treat this roadway.

b) Find width of treatment column at 7.5 m.
Use rate of 1 litre per m2.
Therefore, 1.5 x 7500 = 11,250 litres would be required for subsequent dust control treaments.

Appendix A – Policy

Amendment to Policy with respect to Granular Surface Roadways

(Adopted by Council on January 20, 1988)

Council on April 18th, 1979, adopted the following policy with respect to the maintenance of granular surface roadways, namely:

i) Existing unimproved rights-of-way shall be constructed to an all-weather granular surface and financed as a local improvement. For those properties which are zoned agricultural, the maximum accessible frontage for any single property shall be limited to 300 feet, as provided under Section 370(1) and 383(1) of The City of Winnipeg Act.

ii) Granular surface roadways constructed as a local improvement be maintained at the cost of the City-at-large for a period not in excess of three years from the date of completion of construction.

iii) Beyond the three years referred to in Clause (ii), the City will carry out only those works necessary to keep the roadway passable. These works consist of basic grading only and will not keep the roadway in a condition comparable to that after completion of the local improvement. Restoration of the roadway to the original local improvement construction standard (continuous application of granular material and dust palliative treatment) would only be done at the expense of the fronting owners as a new improvement.

iv) Provide, in the Local Improvement By-Law No. 98/72, for the assessment, as a Local Improvement, the cost of placing gravel and crushed stone on existing gravel surface roadways.

Subsequently, on May 21st, 1980, Council adopted the following policy with respect to dust palliative treatments on collector type streets and bus routes of the City of Winnipeg Transit System:

1) That as a City-at-large expense, a single dust palliative treatment per annum be applied to all gravel roads serving residential and agricultural properties of a collector street type.

2) That as a City-at-large expense, a single dust palliative treatment per year will be applied to all gravel roads used as bus routes by the City of Winnipeg Transit System.

3) That rural gravel roads meeting criteria outlined in recommendation 1) and 2) above be given a dust palliative treatment 150 feet either side of residential buildings only.

On March 4th, 1987, the policy was further amended to provide that a one yearly dust palliative treatment be applied at City-at-large expense, on all gravel lanes and /or streets on the perimeter boundaries of City-owned recreation fields, parks and playgrounds.

The existing policy does not differentiate between gravel roads located within or outside of the Urban Building Limit. In essence, the policy does not allow any gravel road to be regravelled unless a local improvement for placing gravel is approved of by the benefiting property owners or the roadway is a collector-type street/bus route eligible for the single yearly dust palliative treatment union also involves the application of minimal amounts of gravel.

Gravel roads constantly lose gravel from their surfaces due to the particles being ejected by the tires of passing vehicles. In spite of the Operations Department using its graders to try and blade the lost granular material back onto the roadway surfaces from the ditches, all gravel roads have to be periodically regravelled if they are to retain the ability to convey vehicles during all weather conditions. With the Council policy of April 18th, 1979, in place, gravel roads not classified as collector streets or bus routes which have not been subject to local improvements are now beginning to become impassable during periods of wet weather due to a lack of gravel.

Even the collector-type streets and bus routes, which receive a minimal amount of gravel in conjunction with the application of the yearly dust allaying treatment, have deteriorated to the point where their surfaces can become unreliable during heavy periods of rain. Gravel streets that have become badly rutted and filled with mud holes are not graded by the Operations Department until the roadway dries out, as operating the heavy equipment on the saturated surface will only make the situation worse.

In order to temporarily remedy this situation, a minimal application of a one-inch thick layer of gravel would have to be applied to all such deteriorated roads so that they could gain or retain an all-weather conveyance capability.

The application would not return the gravel roads to their condition as they existed in 1979 because the loss of gravel has been substantial since that time. Regravelling with a one-inch thick layer of gravel would likely have to be carried out every two or three years if the thoroughfares are to continue to be passable during all weather conditions.

The estimated cost associated with the one-inch thick gravel placement on a City-wide basis is as follows:

175.8 kilometers x $6,600/kilometer = $1,160,000.00

In accordance with the existing policy, gravel roads either within or beyond the Urban Limit Line are not given dust suppression treatments unless they have been the subjects of local improvements for such work or designated as being collector streets or bus routes. The estimated cost of providing a once yearly dust treatment on roadways in front of all those residential properties not already receiving such service is $213,000.00.

Insofar as the blading of the gravel roads in the City is concerned this work is carried out on an as-required basis following inspections which determine whether or not the work is required.

A questionnaire regarding the maintenance of gravel roads was sent to each of the eight municipalities surrounding the City of Winnipeg. It appears that all of the municipalities apply gravel and dust palliatives to their roads at the expense of the municipality-at-large. The regravellings occur generally on a yearly basis with some municipalities applying gravel on a two-year cycle. On the other hand, the applications of materials for dust control purposed vary from once a year for most municipalities and up to three times a year for some others. Most municipalities grade their gravel roads every two weeks or more often depending on the weather conditions as the minimum level of service that is given to those thoroughfares.

On September 15th, 1987, your Committee on Works and Operations considered the following proposals from the Executive Policy Committee:

1) That as a City-at-large expense, that two palliative treatments per annum be applied to all gravel roads serving residential and agricultural properties of a collector street type.

2) That as a City-at-large expense, two dust palliative treatments per year be applied to all gravel roads used as bus routes by the City of Winnipeg Transit System.

3) That other rural gravel roads outside the urban limit line meeting criteria outlined in recommendations 1 and 2 above be given a dust palliative treatment 150 feet either side of residential buildings only,

As well as the following submission from Councillor Clement:

"That the existing policy on gravel road maintenance as adopted by Council on April 18th, 1979 and modified on May 21st, 1980 and again on March 4th, 1987 be amended effective in 1988 to provide for:

a) As in March 4th, 1987 amendment that a dust palliative treatment be applied on all gravel lanes and/or streets on the perimeter boundaries of City-owned recreation fields, parks and playgrounds.

b) A one-inch thick gravel application to be carried out approximately every two or three years if required on gravel roads in agriculturally zoned areas.

c) That two dust palliative treatments per annum be applied to all gravel roads serving residential and agricultural properties of a collector street type.

d) That two dust palliative treatments per year be applied to all gravel roads used as bus routes by the City of Winnipeg Transit System.

e) A yearly application of a dust palliative on rural gravel roadways, 50 feet either side and in front of those residential properties not already receiving such services.

f) That established unimproved roadways inside the urban limit line as designated by Plan Winnipeg, that have adjoining lands that have R1 Zoning be maintained to a road oiling Type II level of service carried out every three to five years as required.

g) That funds be provided for this purpose in future Current Budgets beginning in 1988."

Your Committee referred the foregoing proposals to the administration to determine the costs involved to implement same throughout all areas of the City.

The three proposals from the Executive Policy Committee appear to have been incorporated into Councillor Clement's submission with the only anomaly being the 150 feet of dust palliative to be applied on either side of residential buildings specified in the third proposal from the Executive Policy Committee as compared to the fifty foot dimension for dust treatment to be placed on either side and in front of residential buildings as indicated in Clause a) of Councillor Clement's proposal. As the 150 foot dimension has been utilized as the standard measurement for such dust allaying operations since 1980, all costs have been estimated using this figure. The cost implications of Councillor Clement's submission are discussed on a clause by clause basis as follows: -

Clause a)

"As in March 4th, 1987 amendment that a dust palliative treatment be applied on all gravel lanes and/or streets on the perimeter boundaries of City-owned recreation fields, parks and playgrounds."

This proposal will be provided for in the Operation Department's 1988 Preliminary Current Estimates as a continuation of such work carried out in 1987, and therefore there will be no additional new funding required to carry out this program.

Clause b)

"A one-inch thick gravel application to be carried out approximately every two or three years if required on gravel roads in agriculturally zoned areas."

There are approximately 137 kilometers of gravel roads situated within and beyond the Urban Limit Line that service agriculturally zoned properties. On the assumption that these thoroughfares would be regravelled, on average, once every two and one-half years, the additional annual cost in 1988 would be $361,700.00.

It is to be noted that there is a significant length of gravel roads in the City, approximately thirty kilometers, that serve properties that are not agriculturally zoned, that is, commercially and industrially zoned lands as well s the residentially zoned areas beyond the Urban Limit Line, such as South Headingley. In the event that this same service level is extended to these roads, the additional annual cost in 1988, would be $79,200.00.

Clauses c) and d)

c) "That two dust palliative treatments per annum be applied to all gravel roads serving residential and agricultural properties of a collector street type."

d) "That two dust palliative treatments per year be applied to all gravel roads used as bus routes by the City of Winnipeg Transit System."

The additional annual cost in 1988 of applying the second dust palliative treatment to all gravel collectors and bus routes serving residential and agricultural properties would be $157,800.00.

Clause e)

"A yearly application of a dust palliative on rural gravel roadways, 50 feet either side and in front of those residential properties not already receiving such services."

The additional annual cost in 1988 of applying a dust palliative on rural gravel roadways in front and beside those residential properties not already receiving such service, is $115,000.00. Should it be deemed desirable to extend the application of dust palliatives to include those gravel roads that serve commercial and industrial properties, then the additional annual cost in 1988 would be $144,000.00.

Clause f)

"That established unimproved roadways inside the urban limit line as designated by Plan Winnipeg, that have adjoining lands that have R1 Zoning be maintained to a road oiling Type II level of service carried out every three to five years as required."

The total length of gravel roads within the Urban Limit Line that serve residentially zoned properties is approximately ninety-nine kilometers. Assuming that these roads are given a Type II oiling, on average, once every four years, the additional annual cost in 1988 would be $730,100.00.

Note: A Type II Oiling consists of a moderate amount of scarifying and compacting of the existing roadway surface, the placing of a one-inch thick (approximate) lift of gravel and an application of sand and oil.

Your Committee on Works and Operations recommends: -

1) That the existing policy on gravel road maintenance as adopted by Council on April 18th, 1979 and modified on May 21st, 1980 and again on March 4th, 1987 be amended effective in 1988 to provide for: -

    i) (As in the March 4th, 1987 amendment that) a dust palliative treatment to be applied on all gravel lanes and/or streets on the perimeter boundaries of City-owned recreation fields, parks and playgrounds.

    ii) A one-inch thick gravel application to be carried out approximately every two or three years if required on gravel roads in agriculturally zoned areas

    iii) That two dust palliative treatments per annum be applied to all gravel roads serving residential and agricultural properties of a collector street type.

    iv) Two dust palliative treatments per year be applied to all gravel roads used as bus routes by the City of Winnipeg Transit System.

v) A yearly application of a dust palliative on rural gravel roadways, 150 feet either side and in front of those residential properties not already receiving such services.

vi) Established unimproved roadways inside the urban limit line as designated by Plan Winnipeg, that have adjoining lands that have R1 Zoning be maintained to a road oiling Type II level of service carried out every three to five years as required.

vii) That funds be provided for this purpose in future Current Budgets beginning in 1988.

2) That the proper officers of the City do all things necessary to implement the foregoing.