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MAINTENANCE MANAGEMENT MANUAL

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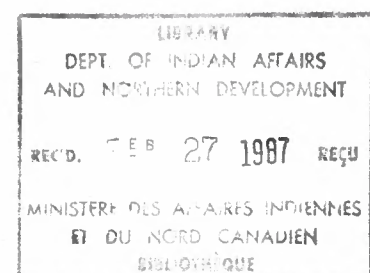
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**Technical Services
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MAINTENANCE MANAGEMENT MANUAL

May 1985



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Guide de gestion de l'entretien

MAINTENANCE MANAGEMENT MANUAL

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MAINTENANCE MANAGEMENT MANUAL

1.0 INTRODUCTION

This publication is intended to provide Indian bands with direction and guidance in organizing the maintenance of physical facilities on reserves. It provides a means of:

- a. identifying all assets requiring maintenance (inventory);
- b. defining the types of maintenance tasks that have to be performed on each asset (activities), and what should be done under each activity (task statements);
- c. defining how often the activities should be performed (frequency of service);
- d. indicating how long each task should take to complete (productivity);
- e. planning the maintenance workload for the entire year (annual work program);
- f. budgeting for the maintenance program in terms of personnel, equipment and material requirements, and cost (performance budget); and
- g. authorizing work to be done in accordance with the annual work program (work register and work order).

The objective is to use these system elements in a planned, orderly maintenance program in order to minimize repairs and satisfy DIAND maintenance quality standards for departmentally owned assets, (see 10.0).

Maintenance is the work performed on an asset such as a road, building, or piece of equipment to preserve it in as near to its original condition as is practical. The types of maintenance which can be performed include:

- a. routine - ongoing maintenance activities such as cleaning, grading roads and mowing required because of continuing use of the facilities;
- b. preventive - periodic adjustment, lubrication and inspection of mechanical equipment to ensure a continued working condition; and
- c. major maintenance projects such as floor replacement, re-roofing, or painting performed every few years.

Repair is restoring by replacing a part or putting together what is broken or damaged. The need for repairs can result from normal wear, vandalism, misuse, or improper maintenance.

2.0 INVENTORY

2.1. General Remarks

Inventory is the listing of the physical features that require maintenance. The types of data to be kept vary with the activity (see 8.0) and the task statement (see 3.0). The following table gives examples of the types of inventory detail.

| <u>Activity</u> | <u>Inventory Items</u> |
|------------------------------|--|
| 1100 - Building Custodial | - m ² of floor surface - no. of light fixtures/bulbs - no. of doors |
| 1101 - Building Cleaning | - m ² of floor surface - no. of windows - m ² of wall area |
| 1302 - Culvert Inspection | - no. of culverts |
| 1306 - Mowing | - km of roadway |
| 1310 - Ditching | - km of ditches |

2.2 Inventory Collection

The collection of all inventory is done according to the Maintenance Management Inventory System as described in Appendix A.

Figure 1 is an example of the form required to record building data.

Other categories of assets such as grounds and roads also require specialized forms.

3.0 TASK STATEMENTS/FREQUENCY OF SERVICE

3.1 General Remarks

A task statement is a detailed list of the specific tasks to be performed in conducting preventive or routine maintenance operations.

Frequency of service refers to the frequency with which maintenance tasks are performed, for example, daily, weekly or every five years.

3.2 Task Statement/Frequency of Service Relationships

Each task statement relates to a specific activity and asset or component. A particular component, such as a boiler, may require weekly, monthly, quarterly, and annual maintenance checks. Each activity requires a different task statement.

Likewise, a specific asset, such as a road, may have a single task statement, such as grading, to be repeated a number of times during the year.

3.3 Preparing Task Statements

Following the inventory, the preparing of task statements is the first step in setting up the maintenance management system.

To simplify the preparation of task statements, a large number of typical or "standard" task statements have been prepared to cover most of the assets, one is likely to have on a reserve (see Appendix B).

To prepare a set of task statements applicable to a particular reserve, copy those that apply to each of

Figure 1



Indian and Northern Affairs Canada Affaires indiennes et du Nord Canada

BUILDING SUMMARY CARACTÉRISTIQUES GÉNÉRALES DU BÂTIMENT

MAINTENANCE MANAGEMENT INVENTORY RÉPERTOIRE DE LA GESTION DE L'ENTRETIEN

| MAINTENANCE MANAGEMENT INVENTORY | | | | | | | | | | Page | of de |
|---|--|---|--------------------------------------|---|---|---|---|---|--|----------------------------------|--|
| RÉPERTOIRE DE LA GESTION DE L'ENTRETIEN | | | | | | | | | | | |
| B-2, C-2, C-4 Material - Matériaux | | | | | | | | | | | |
| A | Acoustic Tie Panel Carreaux, panneaux acoustiques | G | Carpet - Moquette | H | Ceramic, Quarry Tile Carreaux de cérami- que, de carrière | M | Glass, Transparent Material Verres, matériaux transparents | S | Pre finished Hardboard Bois franc préfini | Y | Wood Shake, Shingle Bos, bardeaux de ferme, bardeaux |
| B | Asbestos Cement Amanite-ciment | I | Cloth, Fabric Tissu | N | Gypsum Board Placoâtre | T | Essential Tile, Sheet Couvre-planchers essentiels en carreaux, en feuilles | Z | Other Autres | | |
| C | Asphalt Shingle Bardeaux d'asphalte | J | Concrete Block Blocs de béton | O | Log - Billes de bois | U | Stone - Pierre | | | B-3, C-3, C-5 Finish Finition | |
| D | Asphalt, Tar Roll Rouleau de papier- feutre asphalté | K | Concrete, Cement Béton | P | Metal - Métal | V | Terrazzo - Terrazzo | | | P | Painted Slatting Oil Huile de peinture, huile |
| E | Brick - Brique | L | Exposed Insulation Isolant exposé | Q | Metal Siding Parament en métal | W | U-Terrazzo - Terrazzo | | | U | Unpainted Non-peinture |
| F | Built-up Roofing Couverture multicouche | | | R | Plaster, Stucco Enduit, stuc | X | Wood, Plywood Bois, contre plaqué | | | | |

| | | | | |
|--|--|------------------------------------|-------------------------------------|---|
| Date Y A M D-J 1 | Asset Category Catégorie de bien 2 | Asset Class Classe de bien 3 | Asset Number Numéro du bien 4 | Site Number Numéro de l'emplacement 5 |
| Site Name Nom de l'emplacement 6 | Asset Name Désignation du bien 7 | | | |

B. WALLS - MURS

| Description | Material Matériau | Finish Finition | Net Area Superficie nette (m ²) | Total No of Doors Nbre total de portes | Total Area of Windows Superficie totale des fenêtres |
|-------------|----------------------|--------------------|---|---|--|
| 1 | 2 | 3 | 4 | 6 | 7 |
| | | | | | |
| | | | | | |
| | | | | | |
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C. FLOORS/CEILINGS - PLANCHERS/PLAFONDS

[illegible]

D. EXTERIOR - EXTÉRIEUR

| Description | | Material Matériau | Finish Finition | Net Area Superficie nette (m ²) | Total Net Exterior Wall Area Superficie totale nette des murs extérieurs (m ²) |
|-----------------------|--|----------------------|--------------------|---|--|
| 1 | | 2 | 3 | 4 | 5 |
| W A L L S | | | | • | • |
| | | | | • | Total Roof Area Superficie totale du toit |
| | | | | • | |
| | | | | • | |
| R O O F | | | | • | • |
| | | | | • | |

the assets inventoried, review them and make any justifiable changes necessary to suit the particular asset, equipment or component. This will provide the required level of service and meet the appropriate quality standard.

Where no standard task statement is available for a particular asset or component, a new one will have to be developed using the standards as examples.

3.4 Task Statement Sheets

Figure 2 is a sample task statement.

4.0 WORK ORDER MASTER

4.1 General Remarks

The work order master (Figures 3 and 4) is a heavy stock card containing activity, location, inventory, and task statement information. The card forms the basis for defining and establishing a work program, and authorizing work to be done in accordance with the program.

New master cards are prepared as facilities are added or modified, based on inventory data and task statements.

The master cards form a central file which identifies all the assets and components included in the maintenance program. A work order to authorize maintenance work and record time worked can be obtained by photocopying the master.

4.2 Data Block Definitions

The work order master data blocks are explained below. Sample information used in Figure 3 is given in brackets below:

- a. Site - give the reserve name (West Bay).

Figure 2

Activity No.

1106.3

TASK STATEMENT

| | | | |
|--|---------------------|--------------|----------------|
| CATEGORY | - BUILDINGS | ACTIVITY | - EQUIPMENT PM |
| COMPONENT | - Air Compressor | | |
| FREQUENCY OF SERVICE | See below | | |
| EQUIPMENT | - Rags, wrench, oil | | |
| CREW | - 1 person | | |
| PRODUCTIVITY | - See Below | | |
| <p><u>WEEKLY</u> (0.25 h/unit)</p> <ul style="list-style-type: none"> - Visually check operation. Check for leaks (air and oil). - Hold hand on motor. Check for excessive temperature and vibration. - Open drain cock. Drain moisture from tank. Close. - Visually inspect belts for wear, side cuts, glazing. - Check oil level. Top up with SAE #10 oil if required. - Drain moisture from air line filter. <p><u>MONTHLY</u> (0.16 h/unit)</p> <ul style="list-style-type: none"> - Check air intake filter. Clean unit. - Pull O-ring on relief valve to test operation clean. <p><u>QUARTERLY</u> (0.33 h/unit)</p> <ul style="list-style-type: none"> - Lubricate motor with SAE #20 oil. - Drain compressor crankcase. Refill with SAE #10 oil. - Wipe off all excess oil. - Clean dirt from cylinder fins with a clean rag. <p><u>ANNUALLY</u> - (1 h/unit)</p> <ul style="list-style-type: none"> - Check efficiency of compressor by isolating and draining tank, and timing the pump-up time required to go from 60 to 100 p.s.i.; if the time doubles from first year, have the compressor serviced. - Tighten all mounting bolts. | | | |
| DATE APPROVED | 10/22/82 | DATE REVISED | 07/05/84 |

15/05/85

- b. Classification (Category) - either Buildings, Grounds, Roads, Maintenance Projects, Fire Protection Equipment, Utilities, or Capital Projects (Buildings).
- c. Card Number - a reference number assigned under each category.
- d. Asset - the specific asset (Lakeview school).
- e. Activity Description - a brief description of the work to be performed (Equipment PM-Weekly).
- f. Activity Number - the four-digit activity code (1106 - Building Equipment PM).
- g. Location - the specific area where the equipment is located (Boiler Room-Lakeview).
- h. Week - the week when the work is to take place. This is completed when copies of the work order master are made.
- i. Inventory - a listing of all the inventory items included on the card.
- j. Crew - the crew needed to perform the work (1 person).
- k. Tools Required - any special tools required to perform the work (flashlight).
- l. Work to be Performed - a detailed listing of the work to be done. This is normally a number of task statements relating to the items listed under inventory.
- m. Time - indicate the expected amount of time to perform each task listed under Work to be Performed. The total of all tasks is entered in the Planned Time block (2 hours).
- n. Time Worked - the photocopy of the work order master is intended to serve as a time sheet. The hours worked for each work order are recorded in the appropriate day blocks.

Figure 3

WORK ORDER

| | | |
|---|--|---|
| SITE West Bay | CATEGORY Buildings | CARD NO. B-101 |
| ASSET Lekeview School | ACTIVITY DESCRIPTION Equipment P.M. - Weekly | ACTIVITY NO. 1106 |
| LOCATION Boiler Room - Lekeview | | WEEK |
| INVENTORY <div style="display: flex; justify-content: space-between;"> <div> Boiler Room 2 - Boilers 2 - Hot Water Tanks 2 - Air Compressor 1 - Standby Generator </div> <div> Lekeview School 1 - Sump Pump 4 - in line Pumps 1 - Expansion Tank 38 - Valves </div> <div> Fan Room 3 - Strainers 1 - Control Valve 1 - Air Handling Unit Roof 3 - Exhaust Fans </div> </div> | | CREW 1 Person TOOLS REQ'D flashlight |
| WORK TO BE PERFORMED | | TIME |
| Lekeview School - Boiler Room 2 Boilers - visually check operation. Check boiler temperature (140° F minimum, 180° F maximum). - check flame. If smoky, call serviceman immediately. - check fuel lines and tanks for leakage. 2 Hot Water Tanks - visually inspect unit for leaks. - check combustion flame. Call serviceman if smoky. - check fuel lines and tanks for leakage. 1 Air Compressor - visually check operation. Check for leaks (air & oil) - hold hand on motor. Check for excessive temperature and vibration. - open drain cock. Drain moisture from tank. Close. - visually inspect belts for wear, side cuts, glazing. - check oil level. Top up with SAE # 10 oil if required. - drain moisture from air line filter. 1 Standby Generator - visually inspect unit. Check for leaks. - check oil level. Add oil if required. - check fuel level. Check sediment bowl for water or dirt. If dirty or wet, inspect entire fuel system (tanks, lines), correct problem and replace fuel filters. - check engine ventilation openings; check air cleaner. - check cable and battery connections. - check battery electrolyte levels. Top us with distilled water if required. - check engine coolant level, belt tension. - run engine until operating temperature reached plus 30 minutes. Check for unusual noises or vibration. Check exhaust system for leaks. - check fuel tanks and lines for leakage. | | |
| List materials used and repairs required on back | | PLANNED TIME 2 hours |

| NAME | TIME WORKED | | | | | | | TOTAL |
|------|-------------|-----|-----|-----|-----|-----|-----|-------|
| | mon | tue | wed | thu | fri | sat | sun | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

Figure 4

| |
|-----------------------------|
| FREQUENCY OF SERVICE |
| EQUIPMENT |
| CREW |
| METHOD |

- o. Frequency of Service - indicate the level of service provided for the activity.
- p. Equipment - list the equipment required to perform the work.
- q. Crew - the recommended crew to perform the work effectively.
- r. Method - any special methods or procedures to be followed.

4.3 Generating a Work Order Master

Work order masters are prepared from inventory data and task statements. Each master lists tasks for the same frequency of inspection for a number of assets or components in the same geographical location. For example, one card could contain all of the inventory and task statements for weekly school boiler room inspections. The next card could contain all the task statements and inventory for monthly inspections, and so on. The general guidelines for preparing a work order master are as follows.

- a. Examine the physical location of the equipment to be maintained. If an individual is going to a specific area, the inspections should be grouped so that one trip is sufficient to perform all of the PM tasks in that area for that frequency.
- b. Examine the nature of the inspections to be performed. If the task is a large one, such as an annual overhaul, it may be better to put only one task on each card.
- c. List the inventory to be maintained, the location, activity, description, etc., on a blank work order card and the appropriate portions of the task statement sheet.
- d. Calculate or estimate the times needed to complete the individual tasks and enter the total time for all tasks in the planned time block. This total time becomes the basis for personnel planning.

- e. Complete any remaining blocks with available data. Most of the required data are on the task statement sheets.

Completed work order masters are grouped according to major categories. Within each category the cards are grouped by activity number and numbered sequentially, with the first card in each classification (category) numbered 101.

The work order masters should be filed in a ledger tray, grouped by categories and in card number order. The master cards should never leave the tray except to be photocopied or updated.

4.4 Use of the Work Order Master

4.4.1 General Remarks

The work order master is used to:

- a. provide a permanent file of all routine and preventive maintenance to be performed and the assets or components to be maintained;
- b. authorize PM and routine maintenance;
- c. authorize repair work resulting from inspections or equipment failures;
- d. record the total time worked on various activities; and
- e. define the overall work load and develop a work program.

4.4.2 Authorizing PM and Routine Maintenance

The maintenance defined by the work order masters is distributed throughout the year and the work on each task is assigned a specific week on the work register. The work register is discussed in detail in 7.0. Consulting the Work Register every week will indicate which work order masters are to be photocopied and issued.

4.4.3 Authorizing Repair Work

When repairs are required, a photocopy of a blank work order master is filled in, indicating location, equipment requiring repairs, work to be performed, and estimated time if possible. This copy serves as a work order authorizing the repairs and as a sheet for time worked.

All work performed should be authorized by a work order, whether it is PM (copy of completed work order master) or repairs (copy of blank work order master). This ensures overall control of the operation and the proper recording of time worked.

4.4.4 Collecting Time Worked

Work order copies are issued once a week for PM and routine maintenance according to the work register, or as required for repairs. As the work is performed, the amount of time each individual works is written in the time worked boxes at the bottom of the form. When the job is completed, which may take one or more days, the photocopy is returned to the maintenance supervisor. In addition to the time worked, the work orders for road maintenance have blocks for collecting information on the equipment used. The number of hours each piece of equipment is used is entered for each day.

5.0 WORK PROGRAM

5.1 General Remarks

The work program, or the total amount of maintenance work to be performed, is prepared annually to define and balance the work load, identify peaks where part-time labour is required, and serve as a basis for the performance budget. This is the responsibility of the maintenance supervisor and is based on work order masters, historical repair records, and longer-term programs for capital and maintenance projects.

5.2 Maintenance Management System Annual Work Program

The work program is described on the Maintenance Management System Annual Work Program (Figure 5). The data blocks of the sheet are explained below:

- a. Card No. - the card number of the individual work order masters (R-101, R-102, etc.).
- b. Frequency - the number of times each year the work is to be performed. For example, a weekly inspection will be performed 52 times every year unless there is an annual shut-down when the equipment is not in use.
- c. Description - a brief description of the work indicated on the work order master or other work required.
- d. Activity No. - the activity number corresponding to the work to be done.
- e. Hours - the total time to perform each task indicated. This is the planned time indicated on the work order master card.
- f. Weeks - each block represents a two-week period when the work is to be performed.

5.3 Developing an Annual Work Program

The example shown in Figure 5 illustrates how a work program is developed:

- a. Card Number B-101, activity number 1106, outlines a weekly equipment inspection for the Lakeview School boiler room. Being a weekly inspection, it is performed 52 times during the year.
- b. The inspection takes two hours. Each column following records the number of hours worked in every two-week period. Two hours once a week is therefore recorded as four hours.
- c. Card Number B-102 is similar except that each inspection takes one hour.
- d. Card Number B-103 is a monthly inspection for the same equipment. This inspection is performed 12 times a year, and each inspection takes six hours. The six-hour inspections are distributed evenly over 12 two-week periods throughout the year.

Figure 5

[illegible]

- e. Card Number B-113 is a weekly inspection of furnaces at various locations. Since furnaces do not operate during the summer, only 40 weekly inspections are done in conjunction with monthly, quarterly, and annual inspections.

When all cards have been listed, and the hours distributed, the totals of each two-week period are calculated at the bottom of the chart. The totals in the example range from a low of 29 hours to a high of 106 hours with an average of 53 hours per two-week period. This defines the work load for building equipment PM. This process is repeated for all categories and activities to obtain the work load profile for the year.

5.4 Balancing the Work Load

The range of 29 to 106 total hours indicates that some balancing is required. If we assume this work is performed by one individual working 35 hours a week (70 hours every two-week period):

- a. in weeks 19-20 there is a surplus of $70 - 29 = 41$ hours;
- b. in weeks 31-32 there is a deficit of $106 - 70 = 36$ hours; and
- c. on the average there is a surplus of $70 - 53 = 17$ hours per two-week period.

To balance the work load one may:

- a. assign additional duties such as custodial or repair for periods when there is a surplus of time available;
- b. assign additional part-time personnel for the peak periods (weeks 27 through 32); and
- c. spread some of the work for the peaks back to weeks 25 and 26, and some ahead to weeks 33 and 34. This would result in an average of 36 hours of work a week. The deficit could be taken up with overtime.

Decisions of this type are required to make the total work load as level as possible for staffing and to identify periods when additional help is required. The work register allows finer balancing on an individual week basis although it is not absolutely necessary, as discussed in the following section.

6.0 WORK REGISTER

6.1 Use of the Work Register

The maintenance management work register (Figure 6) is a means of authorizing work and issuing work orders as defined by the work order masters. The register covers the year on a weekly basis and records which work was completed as scheduled, backlogged, or cancelled. Work register pages are prepared under the responsibility of the maintenance supervisor whenever assets are added, deleted or changed.

6.2 Data Block Definitions

Site - (West Bay Reserve).

Year - (1980).

Page - (1).

Week - The week copies of the work order master are issued (1).

Classification - (Buildings).

Card number - The card number shown on the work order master (B-101, B-102, etc).

Planned time - The planned time shown on the work order master (2h, 1h etc).

W/Order - The status of the work order (copy of the work order master). Work orders can be checked:

- A - completed as scheduled,
- B - backlogged, or
- C - cancelled.

Figure 6

MAINTENANCE MANAGEMENT WORK REGISTER

| | | |
|------------------------|-----------|--------|
| SITE: WEST BAY RESERVE | YEAR 1980 | PAGE 1 |
|------------------------|-----------|--------|

| WEEK 1 CLASSIFICATION | CARD NUMBER | PLANNED TIME | W/ORDER | | | WEEK 2 CLASSIFICATION | CARD NUMBER | PLANNED TIME | W/ORDER | | |
|--------------------------|----------------|-----------------|---------|---|---|--------------------------|----------------|-----------------|---------|---|---|
| | | | A | B | C | | | | A | B | C |
| Buildings | B-101 | 2 hrs | | | | Buildings | B-101 | 2 hrs | | | |
| | B-102 | 1 " | | | | | B-102 | 1 " | | | |
| | B-113 | 4 " | | | | | B-113 | 4 " | | | |
| | B-117 | 7 " | | | | | B-117 | 7 " | | | |
| | B-108 | 15 " | | | | | | | | | |
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| WEEK 3 CLASSIFICATION | CARD NUMBER | PLANNED TIME | W/ORDER | | | WEEK 4 CLASSIFICATION | CARD NUMBER | PLANNED TIME | W/ORDER | | |
|--------------------------|----------------|-----------------|---------|---|---|--------------------------|----------------|-----------------|---------|---|---|
| | | | A | B | C | | | | A | B | C |
| Buildings | B-101 | 2 hrs | | | | Buildings | B-101 | 2 hrs | | | |
| | B-102 | 1 " | | | | | B-102 | 1 " | | | |
| | B-113 | 4 " | | | | | B-113 | 4 " | | | |
| | B-117 | 7 " | | | | | B-117 | 7 " | | | |
| | B-103 | 6 " | | | | | B-114 | 8 " | | | |
| | B-111 | 4 " | | | | | | | | | |
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WORK ORDER ACTION

(A) AS SCHEDULED

(B) BACKLOGGED

(C) CANCELLED

15/05/85

6.3 Activity Planning

The work register is created after the annual work program is developed and balanced. Weeks 1 through 4 are used in the example.

- a. Cards B-101, B-102, B-113 and B-117 are daily or weekly cards and, in most cases, will be authorized every week (the exceptions are cards B-113 and B-117 which are not authorized during the summer shut-down.) These are entered in each of the weeks 1 through 4.
- b. The planned time for each of these activities is entered under Planned Time. Card B-117 is shown as seven hours since it is seven daily inspections of one hour each.
- c. The activity on card B-108 requires 15 hours. It can be assigned to week 1 or week 2 if a finer balance of the work load is required.
- d. For weeks 3 and 4, cards B-103, B-111 and B-114 can be assigned to either week 3 or 4. For the example, B-103 and B-111 are moved to week 4 to further balance the work load.
- e. This process is repeated for all 52 weeks and for all entries on the annual work program to generate the final work register.

6.4 Issuing Work Orders

A photocopy of the work order master is considered an authorization of work described on the card. The procedure for issuing work orders for routine and PM tasks is as follows:

- a. The work register book is consulted for the appropriate week. If week 1 is used as an example, page 1 is referred to.
- b. The cards listed for week 1 (B-101, 102, 113, 117, and 108) are removed from the work order master file, as well as page 1 from the work register book.

- c. Photocopies are made of the work order master cards and page 1 of the work register. In this example Week 1 is entered in the week column of the card copies.
- d. The originals are returned to the work order master file and the work register book.
- e. The copies of the work order masters, or work orders, are considered authorization and are given to the persons assigned to perform the work.
- f. The copy of the work register page is kept by the maintenance supervisor as a record of the card copies issued. A single copy can serve a four-week period.

6.5 Processing Work Orders

Issued work orders are processed in one of the following ways:

- a. Completed as scheduled. The work orders for work completed as scheduled are returned to the supervisor with the time worked and a note of any equipment and material used. The supervisor checks off these copies in column A, as scheduled, under the W/Order heading and enters the time worked on the pay distribution sheet for each individual.
- b. Backlogged. If the work cannot be done in the week scheduled, it can be re-scheduled in some other week. Backlogged work orders are checked off in column B of the work register copy. The card number is then written into the appropriate week.

NOTE: Weekly tasks cannot be backlogged since the work order copy will be generated the next week. Any weekly tasks which are not done must be considered cancelled.

- c. Cancelled. Any work which cannot be re-scheduled or done during the week is cancelled. The maintenance supervisor is the only person who can cancel work orders. The reason for cancelling should be written on the work order copy.

The following is an example of how these transactions would be entered for week 1.

- a. Copies of the work order master cards B-101, B-102, B-113, B-117, and B-108 are made. The number 1 is marked in the Week 1 box.
- b. The work described on cards B-101, B-113 and B-117 is done during the week. The cards are returned to the maintenance supervisor who marks these off in column A of week 1 (Figure 6).
- c. The inspection of the boilers indicated on card B-101 shows some repair work is required; therefore, no time is available to complete the other inspections.
- d. Card B-102 requires a weekly inspection which cannot be backlogged. This card is marked as cancelled in column C, listing the reasons on the card copy.
- e. Card B-108 is marked as backlogged and re-scheduled for week 2. The card number and planned hours are marked on the work register copy, and the copy of B-108 is re-issued in week 2.

6.6 Filing Completed Work Order Copies

All work order copies should be returned and filed for future reference. Likewise, all copies of the work register pages should be kept. Work order copies should be filed by the weeks in which they are done or cancelled.

7.0 PERFORMANCE BUDGETS

7.1 Use of the Performance Budget

The performance budget is an activity budget which takes into consideration the costs of the labour, equipment, and material required to perform all of the work identified in the work program.

The performance budget worksheet (Figure 7) is the working document for developing a performance budget.

The maintenance supervisor is responsible for its yearly preparation. The worksheet serves as an element in the final performance budget, and is based on information from the work program, historical records, and updated data for labour, equipment, material and contract services costs.

7.2 Data Block Definitions

- a. Act. No. - activity number (1106). All budgeting is done on the basis of costs for each activity.
- b. Description - (Buildings Equipment).
- c. Card No. - the work order master card number corresponding to the activity (B 101).
- d. Crew Hours - the total crew hours identified in the work program (104).
- e. Size - the size of the crew performing the tasks identified (1).
- f. Person Hours - The total person hours to perform the activity (104). Calculating the person hours for a two-person crew working seven days would be 7 days x 8 hours a day = 56 crew hours. The person hours would be 56 crew hours x 2 person/crew = 112 person hours.
- g. Resource - The type of resources used are labour, equipment, material, or contract services (Labour). For each card identified, there could be up to four lines on the form, each representing a different resource type.
- h. Quantity - The number of units of the resource planned (104 h). This will vary with the type of resource; for example, person hours, equipment hours, tonnes of gravel, contract hours, etc.
- i. Rate - The current or projected dollar value of the particular resource (7.00.) This could be labour rates, equipment rates, material unit costs or contract service rates.

PAGE OF

Figure 7

- j. Amount - Quantity x Rate (728.)
- k. Labour - The dollar amount of the labour resource (728.)
- l. Equipment - The amount of the equipment resource.
- m. Material - The dollar amount of the material resource (26).
- n. Other - The amount of contract services or any miscellaneous costs associated with the activity. These should be identified under description or resource.
- o. Total - The dollar total of all resources (754).
- p. B/F - Sub-totals for each page brought forward when one activity requires more than one page.
- q. Totals - The totals from the Person hours, Labour, Equipment, Material, Other and Total Columns (11 242).

7.3 Use of the Form

The use of the performance budget worksheet is described in the example below. Reference is made to the Annual Work Program (Figure 5) and the Performance Budget Worksheet (Figure 7).

The calculations are for Activity 1106, Buildings Equipment PM. The detail is contained in the annual work program and is transferred to the performance budget worksheet for costing. Each work order master referenced in the work program is listed on the worksheet.

For Activity 1106, Building Equipment PM, the first card is B-101. This represents one two-hour inspection a week by a one-person crew for a total of 104 person hours per year. For a one-person crew, crew hours and person hours are equal.

Under Resource Costing, the labour is costed at \$7.00/h. The cost of the labour resource is \$7.00 x 104 h = \$728.

The only other resource is lubricating grease and oil. The material cost can be determined from historical records or estimated. The estimated material cost is \$26. All figures are taken to the nearest dollar.

The labour and material costs are transferred to the appropriate columns under distribution and the card total calculated.

This is repeated for all the cards listed in the work program (B-101 through B-117). When the cards have been costed, any other requirements not identified by work orders are listed. This would include contract maintenance on oil burners, control system servicing, etc. where outside skills are required. The totals for all resource types for Activity 1106 are then calculated and entered at the bottom of the page or sub-totalled and carried forward.

7.4 Performance Budget Summary

The performance budget summary (Figure 8) is a listing of the totals by activity from the performance budget worksheet.

8.0 ACTIVITIES

The maintenance activities identified in this system apply to the following major categories:

- buildings,
- grounds,
- roads,
- maintenance projects,
- fire protection equipment,
- utilities, and
- capital projects.

These categories represent major departmental budget and accounting groupings and correspond to specific programs. Under these categories are a number of activity descriptions, shown below.

PERFORMANCE BUDGET SUMMARY

PAGE ____ OF ____

| Activity | Description | Total Person Hours | Labour Cost | Equipment Cost | Material Cost | Other Cost | Total |
|----------|----------------------------|--------------------|-------------|----------------|---------------|------------|---------|
| 1100 | Custodial | 1,939 | 13,573 | - | - | - | 13,573 |
| 1102 | Cleaning | 2,344 | 9,376 | - | - | - | 9,376 |
| 1104 | Building Repairs | - | - | - | - | 8,500 | 8,500 |
| 1108 | Buildings Equipment P.M. | 1,270 | 8,884 | - | 318 | 2,050 | 11,252 |
| 1108 | Buildings Equipment Repair | - | - | - | - | 2,800 | 2,800 |
| 13XX | Roads | 2,454 | 18,793 | 23,049 | 3,564 | 5,940 | 49,346 |
| 1402 | Painting - Interior | 788 | 4,992 | - | 4,715 | - | 9,707 |
| | - Exterior | 122 | 793 | - | 621 | - | 1,414 |
| 1800 | Fire Protection - P.M. | 159 | 1,113 | - | - | - | 1,113 |
| 1802 | Fire Protection - Repairs | - | - | - | - | 300 | 300 |
| 1900 | Utilities - P.M. | 118 | 812 | - | - | - | 812 |
| 1902 | Utilities - Repair | - | - | - | - | 1,080 | 1,080 |
| | Sub-totals | | 56,336 | 23,049 | 9,218 | 20,670 | 109,273 |
| | <u>Overhead</u> | | | | | | |
| | Garage | | | | | | 3,000 |
| | Vacation Pay | | | | | | 2,863 |
| | U.I.C. | | | | | | 1,066 |
| | W.C.B. | | | | | | 1,125 |
| | Supervision | 2,080 | | | | | 15,000 |
| | Total | | | | | | 132,617 |

Figure 8

8.1 Buildings

| <u>Activity No.</u> | <u>Activity Name</u> | <u>Description</u> |
|---------------------|-----------------------|---|
| 1100 | Building Custodial | All routine building custodial duties including spot cleaning, minor repairs or adjustments, changing light bulbs, snow removal, and other assorted functions. Does not include preventive maintenance (PM) on equipment or repairs to building components (windows, doors, plumbing, etc.) taking longer than two hours. |
| 1102 | Building Cleaning | Includes daily cleaning functions which require no special equipment and washroom servicing (toilet paper, towels, etc.). This is normally done by a special cleaning staff and does not include spot cleaning done under the custodial activity. |
| 1104 | Building Repairs | All repair jobs, including minor carpentry, floor, window and door repairs, touch-up painting. Generally includes all repairs to building components taking longer than two hours. |

- | | | |
|------|---------------------------------|--|
| 1106 | Building Equipment PM | PM including inspections, minor adjustments, lubrication and annual overhaul of building equipment. PM tasks are defined by work orders. |
| 1108 | Building Equipment Repair | Any repair work to building equipment (alarm, communication and heating system, electrical wiring and equipment, plumbing, pumps, valves, etc.) resulting from a PM inspection or equipment breakdown. |

8.2 Grounds

- | | | |
|------|---|---|
| 1200 | Miscellaneous Field Operations Equipment Repairs | <ul style="list-style-type: none"> a. Housekeeping - cleaning of maintenance area/shed, purchasing of supplies and related maintenance tools and equipment. b. Routine and preventive maintenance on tools and equipment such as cleaning, sharpening, washing, adjusting, greasing and winterizing. c. Major equipment repairs. |
|------|---|---|

| | | |
|------|---|--|
| 1205 | Litter and Debris Collection and Removal | Tasks relating to: a. routine litter pick-up, and b. annual major debris collection and removal. |
| 1207 | Grass Cutting Turf Management | Routing mowing, trimming and raking-up of grass cuttings for three levels of service. Longer range seasonal maintenance activities relating primarily to Level 1 and 2 grass area care (watering, fertilizing, aeration, edging, weed control, etc.). |
| 1215 | Plant Material Maintenance (trees, shrubs, etc.) | Includes care for primarily for: a. newly installed plant materials; and; b. special trees, hedges, shrubs, ground cover, floral display areas. Tasks refer to staking, watering, fertilizing, weeding, pruning, spraying, winter protection etc. |

| | | |
|------|------------------------------------|---|
| 1225 | Tree Removal | The cutting and disposal of dead or hazardous/storm damaged trees on road allowances or in other public use areas. |
| 1226 | Walks and Hard surface Area Upkeep | Maintenance of surfaced areas (paved or unpaved) with materials other than vegetation, such as gravel, asphalt or concrete -- included are driveways, parking lots, pedestrian walks, ramps and steps requiring routine sweeping, minor crack repairs, snow removal and major replacement of settled/eroded segments. |
| 1235 | Outdoor Site Furniture Upkeep | Maintenance associated with the various miscellaneous metal and wood components of a site such as flagpoles, benches, signs, picnic tables, fences, gates, bollards, decks and railings. |
| 1245 | Minor Site Restoration | Maintenance of fringe or transition areas requiring weed and brush control/removal, top dressing to smooth irregular grades for improved mowing, cleaning of open drainage ditches, minor filling to raise grades and miscellaneous seeding and sodding. |

| | | |
|------|--|--|
| 1255 | Ancillary Site Utility Checks | Unspecialized tasks relating to inspections and minor upkeep of grounds category utility items, but not including primary municipal services. Examples are exterior/site water taps, drinking fountains, night lighting for sports fields, car plug-in receptacles, pedestrian lighting fixtures and site drainage structures. |
| 1260 | Children's Play Areas | Work tasks relating primarily to routine safety checks of play area site, structures and apparatus including lubrication, repairs, and replacement of dangerous, broken or missing components. |
| 1265 | Sports Areas and Athletic Fields | Special tasks relating to the proper care, line layout, assembly/disassembly of outdoor sports areas and associated equipment. Examples are hockey rinks, ball diamonds, running tracks, and soccer/football fields. |
| 1275 | Water Front Areas and Erosion Control Edges | Special tasks relating to the care and upkeep of community beach areas, erosion control edges and dock facilities. |

| | | |
|------|---|--|
| 1280 | Cemeteries, Monuments and other unique areas | Specialized tasks required on a site-specific basis. |
| 1285 | Tourist Related Area Maintenance | Work tasks relating to the upkeep of facilities that are specifically associated with tourist oriented economic ventures such as golf courses, marinas, campgrounds and hunting/fishing camps. |

8.3 Roads

| | | |
|------|--------------------------------|--|
| 1300 | Culvert Repair/ Replacement | The repair or replacement of damaged culverts. Includes all the associated work such as detours, backfilling, hauling materials, etc. |
| 1302 | Culvert Inspection | The inspection of culverts for blockage and the removal of sediment and debris from culvert inlets and outlets, and clearing of blockages. |
| 1304 | Litter Pick- up | The removal of trash and debris from roadway rights-of-way, and their disposal. |
| 1306 | Mowing | The mowing of shoulders and roadside areas. |
| 1308 | Ditch Cleaning | The removal of weeds, debris and growth from ditches to ensure proper drainage. |

| | | |
|------|-----------------|---|
| 1310 | Ditching | The re-establishment of ditches, including cutting, shaping and removing material. This is required as a result of long-term filling-in of ditches and loss of proper drainage. |
| 1312 | Grading | The machine grading of gravel roads, including the removal of rocks and debris brought to the surface. |
| 1314 | Dust Control | The application of calcium chloride solution to gravel surfaces. |
| 1316 | Gravel Patching | The repair of potholes, depressions, frost boils, bumps, etc. on localized areas of roads. |
| 1320 | Snow Removal | The removal of snow from road surfaces. Includes plowing, loading, and hauling snow. |
| 1322 | Sanding/Salting | The application of sand or salt to icy road surfaces. Includes hauling and mixing winter sand, and loading trucks. |
| 1324 | Snow Fence | The installation, removal and storage of snow fences. |

| | | |
|------|-----------------------------|--|
| 1326 | Road Equipment PM | PM performed on road equipment. |
| 1328 | Road Equipment Repair | Repairs to road equipment. |
| 1330 | Asphalt Patching | The repair of discontinuous sections using premixed asphaltic materials (hot or cold mix). Includes patching potholes, depressions, bumps and pavement edge defects. |
| 1332 | Crack Sealing | The preparation and sealing of cracks and joints using pour pot or other acceptable equipment. |
| 1334 | Asphalt Resurfacing | The repair of continuous sections to strengthen existing pavements. |
| 1336 | Surface Treating | Sealing and adding life to road surface in continuous sections without strengthening the pavement. |
| 1338 | Spray Patching | The repair of distressed areas of surface, surface edge defects and surface cracks. |
| 1340 | Street Cleaning | Cleaning of road and street surfaces, gutters and medians including all associated work. Includes cleaning up and removing winter sand in the spring. |

| | | |
|------|-----------------------------------|---|
| 1342 | Flushing | Flushing of roads and streets including shoulders and gutters. |
| 1344 | Sidewalk Repair | The repair of broken or otherwise unsatisfactory sections of sidewalks. |
| 1346 | Sidewalk Cleaning | By mechanical, flushing or manual means. Includes cleaning up and removal of winter sand in the spring. |
| 1348 | Catchbasin Cleaning | Cleaning of catchbasins manually or with an educator or bucket machine. Includes manual removal of sticks and stones. |
| 1350 | Catchbasin Connection Repair | Repair of catchbasins and appurtenances. |
| 1354 | Curb and Gutter Maintenance | The repair or replacement of predetermined sections of curbs. |
| 1356 | Road Sign Maintenance | Work related to the installation and maintenance of road signs. |
| 1358 | Guide Post, Guiderail Maintenance | All work related to the maintenance of guide posts and guiderails. |
| 1360 | Pavement Marking | All work related to road pavement marking. |

8.4 Maintenance Projects

| | | |
|------|----------------|--|
| 1400 | Major Cleaning | Major cleaning programs normally done during the summer. |
|------|----------------|--|

| | | |
|-----------|----------------|--|
| 1402 | Major Painting | Exterior and interior painting done as part of the major four-year program. |
| 1404-1498 | Other Projects | Any major maintenance projects such as re-roofing or re-flooring for a specific year. Each project should have its own number. |

8.5 Fire Protection Equipment

| | | |
|------|--|--|
| 1500 | Fire Protection Equipment PM | PM tasks on fire prevention systems including inspections, testing and minor adjustments. PM tasks are identified by work orders. |
| 1510 | Firefighting Apparatus (trucks) | Firefighting vehicles (trucks) |
| 1520 | Firefighting Equipment PM | Firefighting tools used in conjunction with the fire truck, for example, siamese connection, hoses, nozzles and axes. |
| 1530 | Fire Protection Systems Repair | All repairs to fire protection systems, for example, sprinkler, alarm or intrusion systems. |
| 1540 | Firefighting Apparatus (trucks) Repair | All repairs, resulting from PM inspections or failures, to triple combination pumpers (TCP) or vehicles designed only for fire suppression (for example, minipumpers used in BC Region). |

| | | |
|------|----------------------------------|---|
| 1550 | Firefighting Equipment Repair | All repairs to fire suppression equipment used to support the apparatus, resulting from PM inspections or failures. |
|------|----------------------------------|---|

8.6 Utilities

| | | |
|-----------|-----------------------|---|
| 1600-1620 | Water Supply | Preventive and routine maintenance tasks on system components such as mains, valves, pump houses and reservoirs. |
| 1622-1632 | Water Treatment | Consists of all tanks, equipment and processes used in water treatment such as filtration, softening, chlorination etc. Tasks include inspection, testing and related adjustments. |
| 1634-1642 | Wastewater Collection | Preventive and routine maintenance tasks on system components such as utility holes, lift stations, holding tanks etc. |
| 1644-1668 | Wastewater Treatment | Consists of all tanks, equipment and processes used in wastewater treatment such as septic tanks, lagoons and mechanical plants. Tasks include inspection, testing and related adjustments. |
| 1670 | Solid Waste Disposal | Work tasks related to the collection and disposal of solid waste by means of landfill and incineration. |

| | | |
|------|--------|---|
| 1680 | Others | Covers miscellaneous task items such as fuel storage. |
|------|--------|---|

8.7 Capital Projects

| | | |
|-----------|-------------------------|---|
| 1700-1798 | Capital Project Name | All capital projects relating to the construction or installation of new assets. Each project should have its own number. |
|-----------|-------------------------|---|

9.0 SUGGESTED ACCOUNTING STRUCTURE

9.1 Elements

The suggested accounting structure and related budgeting process reflect the philosophy of maintenance management. Maintenance management is built on the following key elements:

- a. inventory - the physical items to be maintained;
- b. task statements - the specific tasks to be performed on the various inventory items;
- c. levels of service - how frequently the task statements are to be performed;
- d. resource requirements - the labour, equipment, material, and other resources required to perform the maintenance tasks;
- e. activities - the types of maintenance operations being conducted;
- f. a work program - the total personnel required and the overall annual schedule for performing the various maintenance activities; and

- g. a performance budget - the total maintenance cost, including cost factors for the input resources.

The work program represents the maintenance plan, through which personnel and material expenses can be tracked. In developing this plan a number of the elements are fixed and a number are somewhat variable.

9.2 Fixed Elements

9.2.1 Inventory

The inventory is fixed by the assets to be maintained. All assets, regardless of their nature, require some level of maintenance.

9.2.2 Task Statements

The work to be performed on individual assets is generally fixed by acceptable and technically sound maintenance procedures. The only changes in these procedures would be reflected by advances in technology.

9.2.3 Activities

It is desirable to have the activity definitions as fixed as possible to maintain continuity. Activity definitions would change only as a result of the addition of completely new types of assets.

9.3 Variable Elements

9.3.1 Frequency of Service

In general, the frequency of service provided is determined by the use of the asset. A road, building or piece of machinery subjected to high usage levels will necessarily require higher maintenance levels. The frequency of service, however, has definite limits below which maintenance is inadequate or above which there is no cost benefit.

9.3.2 Resource Requirements

These are a function of the inventory and the frequency of service provided, and define the work program.

9.4 Fiscal Structure

In order to provide continuity in the fiscal structure and ease of comparison of year-to-year figures, the following fiscal accounts are recommended.

| <u>Category</u> | <u>Activity No.</u> | <u>Description</u> |
|-----------------------------|-------------------------|----------------------------|
| <u>Buildings</u> | 1100 | Buildings Custodial |
| <u>11XX</u> | 1102 | Buildings Cleaning |
| | 1104 | Buildings Repairs |
| | 1106 | Buildings Equipment PM |
| | 1108 | Buildings Equipment Repair |
| | 11XX | Future Expansion |
| <u>Grounds</u> | 1200 | Grounds |
| <u>12XX</u> | | |
| <u>Roads</u> | 1300 | Culvert Repair/Replacement |
| <u>13XX</u> | 1302 | Culvert Inspection |
| | 1304 | Litter Pick-up |
| | 1306 | Mowing |
| | 1308 | Ditch Cleaning |
| | 1310 | Ditching |
| | 1312 | Grading |
| | 1314 | Dust Control |
| | 1316 | Gravel Patching |
| | 1320 | Snow Removal |
| | 1322 | Sanding/Salting |
| | 1324 | Snow Fence |
| | 1326 | Roads Equipment PM |
| | 1328 | Roads Equipment Repair |
| | 1330-1398 | Administrative and Future |
| <u>Maintenance Projects</u> | 1400 | Major Cleaning |
| <u>14XX</u> | 1402 | Major Painting |
| | 1404-1498 | Other Projects |

| | | |
|-------------------------|-----------|----------------------------|
| <u>Fire Protection</u> | 1500 | Equipment PM |
| 15XX | 1502 | Equipment Repair |
| <u>Utilities</u> | 1600 | Utilities Equipment PM |
| 16XX | 1602 | Utilities Equipment Repair |
| <u>Capital Projects</u> | 1700-1798 | Various Projects |
| 17XX | | |

Under this structure, each activity would represent a sub-ledger account (1300, 1302, etc.) with financial details kept on:

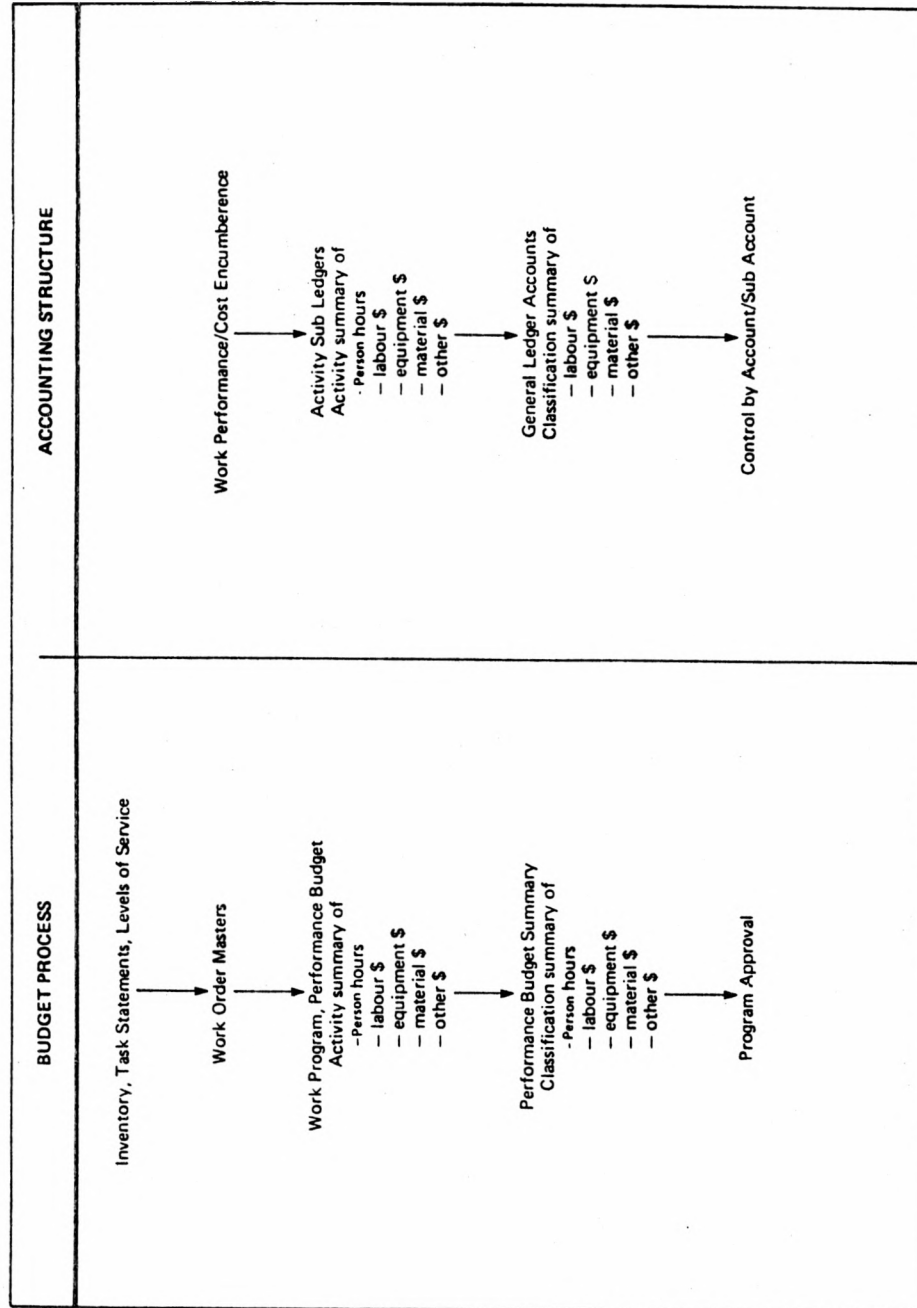
- labour,
- equipment,
- material,
- personnel, and
- other.

The sub-ledger totals would be posted to general ledger control accounts as defined by the category (buildings, roads, etc.) This structure parallels the budgeting process as work order detail is summarized as activity detail which is further summarized as categories.

The categories are intended to be existing programs for budgeting and approval purposes, supported by activity detail. In turn, once the programs are approved, fiscal control is exercised at a classification level, supported by activity sub-ledger detail.

Figure 9 illustrates the relationship between the budgeting process and the accounting process. The major objective is to keep the budget and accounting structures as mirror images of each other.

Figure 9



10.0 DIAND QUALITY STANDARDS

10.1 Buildings

- 1 - cleaning/custodial
- 2 - building structures
- 3 - building services
- 4 - heating, ventilation and air conditioning

10.2 Grounds

- 1 - general remarks
- 2 - miscellaneous field operation and equipment repairs
- 3 - litter and debris collection
- 4 - grass cutting
- 5 - turf management
- 6 - plant material maintenance
- 7 - tree removal
- 8 - walks and hard surface areas
- 9 - site furniture items
- 10 - site restoration activities
- 11 - ancillary site utility items
- 12 - children's play areas
- 13 - sports areas and athletic fields
- 14 - waterfront areas and erosion control edges
- 15 - unique areas
- 16 - tourist related areas
- 17 - site related lighting systems

10.3 Roads

- 1 - culverts
- 2 - roadside litter pickup
- 3 - ditches
- 4 - street/road
- 5 - base and subgrade repairs
- 6 - gravel surfaces
- 7 - bituminous surfaces
- 8 - roadside tree, brush and weed control
- 9 - roadside grass control
- 10 - bridge maintenance
- 11 - curbs and gutters
- 12 - signs
- 13 - guide rail/guide posts
- 14 - winter operations
- 15 - snow fence erection and removal
- 16 - road lighting system

10.4 Fire Protection

- 1 - systems
- 2 - firefighting apparatus (trucks)
- 3 - firefighting equipment

10.5 Utilities

- 1 - water supply systems
- 2 - wastewater systems
- 3 - solid waste systems
- 4 - electrical power generation/distribution systems

10.0 DIAND QUALITY STANDARDS

10.1 Buildings

10.1.1 Cleaning/Custodial

The major objectives for cleaning/custodial are:

- a. To provide a hygienic and sanitary environment in buildings.
- b. To provide an aesthetically pleasing appearance.
- c. To protect the capital investment in building assets.
- d. To reduce snow and ice danger to pedestrians near building structures.

The level-of-maintenance for cleaning/custodial shall be in accordance with the following:

- a. Building structural surfaces and related fixtures and furnishings shall be cleaned to reduce dirt and control bacteria, parasites, viruses and disease.
- b. Designated walks, doorways, steps, etc. shall be cleared of snow and ice to provide safe entrance and exit to building structures.

10.1.2 Building Structures

10.1.2.1 General Remarks

The major objectives for building structures are:

- a. To preserve the capital investment in the structure.
- b. To provide an aesthetically pleasing appearance to building structures.
- c. To eliminate hazards to users of the building.

The level-of-maintenance for building structures shall be in accordance with the following:

10.1.2.2 Inspection

Routine inspections shall be carried out to identify structural deficiencies and initiate corrective action.

10.1.2.3 Painting

Building components listed below shall be free of unsightly stains, peeled or blistered paint.

10.1.2.4 Foundations

Foundations shall:

- provide safe transfer of building loads to the sub-soil;
- have no settlement that damages the building structure or foundation;
- be in durable condition, free from cracked, spalled or otherwise unsound materials;
- be waterproof as required to provide dry basements and crawl spaces;
- have subsurface drainage tile operating in accordance with design requirements;
- have finished grades sloping away from foundation walls;
- have runoff from downspouts diverted away from foundation walls; and
- have runoff from roofs and adjacent paved areas controlled to meet design or other requirements.

10.1.2.5 Interior Carpentry Repairs

Interior carpentry repairs shall be in accordance with the following:

- a. Prior to the programmed interior repainting of a structure, all related interior carpentry repairs shall be identified and completed.

b. Load-bearing walls and columns shall adequately support all design loads.

c. All walls and partitions shall be in sound condition and be adequately supported.

d. Walls, cladding and finished surfaces shall be free from:

- cracked, bulged, or otherwise damaged areas;
- missing sections of tile and other masonry finishes;
- loose or defective mortar joints;
- cracks and openings at seals around pipes and ducts passing through walls; and
- deteriorated finished surfaces due to spalling, staining, efflorescence or other causes.

10.1.2.6 Exterior Walls

Exterior walls shall:

- have no holes and no structural cracks;
- have no spalling, chipping, or eroded material;
- have no dried out or loose jointing materials;
- have no leaks at the junction of the brick or other material and mortar;
- have no leaks at flashings;
- have no excessive air leakage at joints between structural frames and masonry;
- have no cracked or buckled wall coatings;
- have no peeled or blistered paint; and
- have no deteriorated finished surfaces.

10.1.2.7 Roofs

Roofs shall be in accordance with the following:

- a. Roof structures shall be adequate to support design loads due to snow, wind or other action.
- b. Roofs shall be waterproof and sloped to shed water effectively.
- c. Roof ventilators shall provide adequate ventilation to the attic and other roof areas requiring ventilation, and shall be vermin-proof.
- d. Foreign matter such as pine needles or moss shall not be allowed to accumulate on roofs.
- e. Flat roofs shall:
 - be free from dried out, exposed, blistered and delaminated roofing felts; and
 - have no loose felts at junction of horizontal and vertical surfaces.
- f. Pitched roofs shall:
 - have no cracked, torn, broken or missing roof coverings; and
 - have no shingles that are unacceptable in appearance due to varying shades of applied paint, or due to a mottled effect in painted shingles, when viewed from ground level.
- g. Flashings shall have no cracks, breaks, dried out membranes, open joints, loose material or fasteners.
- h. Roof drains shall have no corroded or missing strainers.
- i. Gutters and downspouts shall have no leaks, breaks, loose joints, loose fasteners or inadequate slopes, and shall be substantially free of debris.

10.1.2.8 Floors

Structure and related components shall be in accordance with the following:

- a. Floors shall adequately support design loads and shall provide acceptable levels of safety, durability and appearance.
- b. Floors shall be free from defects due to sagging, unevenness, indentations and areas of excessive wear.
- c. Concrete floors shall have:
 - no defects due to cracking, crazing, spalling or dusting, and
 - no cracked or dried out material at expansion joints.
- d. Baseboard and trim shall:
 - have no defects due to wear, splitting, cracking, corrosion or inadequate fastening; and
 - be of adequate appearance.
- e. Floor fittings, drain covers, grilles, etc., shall be free from defects due to corrosion and other causes.

10.1.2.9 Floor Coverings

Carpets shall:

- be free from compression, burns, stains, tears or cuts;
- be free of moth and other insect damage;
- be firmly anchored with no loose or damaged bases, binding strips or thresholds;
- be fire resistant;

- have no open joints;
- have affective backing; and
- conform to CGSB No. 4-GP-129 and its amendments.

Composition floors shall be:

- adequate in appearance; and
- free of defects due to wear, bulging, burns and stains.

Ceramic tile and quarry tile shall have:

- no defects due to cracking or crazing; and
- no stained, loose or missing grout at the joints.

Hardwood floors shall have no open joints, warping, buckling, or raised or lowered portions of flooring.

10.1.2.10 Ceilings

All ceiling material, including applied finishes, shall be structurally sound and of acceptable appearance.

Ceilings shall be free from:

- saggings, cracks;
- loose and missing tiles and trim;
- staining and corrosion; and
- water penetration, deterioration and damage at ceiling hatches and skylights.

10.1.2.11 Windows

Windows shall be in accordance with the following:

- a. Windows shall be waterproof and free from excessive air leakage.

- b. Exterior window glass shall be cleaned according to the requirements of occupancy and appearance.
- c. Sash and hardware shall operate smoothly.
- d. Windows shall be free of breaks or cracks.
- e. Loose or dried out glazing compound shall be replaced.
- f. Frames, sills and opening sash shall be free from cracking, splitting, warping and corrosion.
- g. Protective coatings shall be free from cracking and peeling.
- h. Damaged or torn screens shall be replaced.
- i. Loose, dried out or missing caulking compound between frames and adjacent surfaces shall be replaced.

10.1.2.12 Doors

All doors, hardware and door closers shall operate safely and efficiently.

Doors shall be free from:

- broken or cracked glazing;
- cracked, loose or dried out glazing compound;
- warping, open joints, distortion, cracks, splits and corrosion in frames;
- excessive wear, looseness, cracks, chipping and corrosion in sills and thresholds;
- loose, dried out and missing caulking compound at joints between frames and adjacent surfaces;
- cracking, peeling and staining of protective finishes; and
- damaged weather stripping.

10.1.2.13 Miscellaneous Interior Building Elements

All elements of the building interior shall be free from defects, and deterioration that affect safety, function and appearance.

Furnishings and furniture shall be free of:

- cracked or crazed finish; and
- peeled or blistered paint.

10.1.2.14 Miscellaneous Exterior Building Elements

All elements of the building exterior shall be free from defects and deterioration that affect safety, function and appearance. Wall-mounted equipment, such as handrails, plumbing fixtures and brackets, light fixtures and brackets and exterior conduit boxes, shall be free from:

- breakage, rust, corrosion, loose joints and connections; and
- peeling, flaking or cracking of surface treatments.

Canopies/Carports shall:

- be adequate to support design loads due to snow, wind or other action and be structurally sound;
- prevent water penetration at joints between the canopy and the building exterior; and
- be free from deteriorated surface finishes.

Verandahs and decks shall:

- be structurally sound, adequately drained, and have no broken and loose railings and supports;
- have floors free from cracks, splits, sags, excessive wear or unevenness; and
- have no deterioration or damaged surface finishes.

Exterior steps, ramps and walkways shall:

- have no displaced or deteriorated foundations;
- have no spalled, cracked or uneven surfaces, deteriorated joints, treads and nosings which affect safety and appearance; and
- be adequately drained.

Fencing shall have:

- no missing posts, caps or crossbars;
- sag limited to design criteria $\pm 10\%$; and
- locks and catches that operate effectively.

Chimneys shall:

- have no holes and no structural cracks;
- have no spalling, chipping or eroded material;
- have no leaks at junction of bricks and mortar;
- have no leaks at flashings; and
- have no excessive build up, on interior surfaces, of soot or resin.

10.1.3 Building Services

The major objectives for building services are:

- a. to protect the investment; and
- b. to ensure equipment is operational.

The level-of-maintenance for building services shall be in accordance with the following:

All building services such as water tank heaters, unit heaters, fractional motors, small motors, large motors, motor controllers, fans, exhaust equipment, watch

circuits, wiring devices, domestic appliances, non-washroom fixtures, etc. shall be subject to federal and/or provincial regulations regarding their design, operation, staff and safety requirements.

10.1.4 Heating, Ventilation and Air Conditioning (HVAC)

The major objective for the HVAC system is:

to provide a centralized controlled atmospheric condition.

The level-of-maintenance for HVAC systems shall be in accordance with the following:

All HVAC systems shall be subject to federal and/or provincial regulations regarding their design, operation, staff, safety requirements, etc.

10.2 Grounds

10.2.1 General Remarks

Grounds are the common denominator for all major facility assets such as buildings, roads and utilities. The constructions and altered use areas occurring in the outdoor spaces between these other major facilities generally fall into the grounds category.

The major objectives for maintaining grounds in general use are:

- to define use areas;
- to improve general appearance and community image;
- to provide safe areas for users;
- to protect initial capital investment in assets;
- to stabilize erosion and improve surface drainage;
- to promote functional use and enjoyment of outdoor spaces; and
- to heal disturbed sites.

The level-of-maintenance for grounds shall be in accordance with the following:

10.2.2 Miscellaneous Field Operations and Equipment Repairs

Grounds maintenance tools, equipment and storage areas shall be:

- kept clean and tidy;
- secure and in good, safe operating condition; and
- protected from abuse and inclement weather.

10.2.3 Litter and Debris Collection

General site areas and the community environs shall be:

- kept free of litter and unhealthy accumulations of trash;
- safe for pedestrian passage; and
- clear of dangerous, unsightly and fire hazardous debris.

10.2.4 Grass Cutting

Grass areas shall be:

- kept reasonably uniform in appearance and colour;
- mowed to appropriate height (see levels of service for grass);
- trimmed as recommended;
- kept free of litter; and
- adequately drained and smoothly graded.

NOTE: Grass areas shall also be identified and maintained to three basic levels of service.

Level 1 (Comprehensive Care)

High use, publicly exposed areas such as front lawns and public building sites such as schools, band halls, etc. (finished mowing height - approximately 50 mm (2")).

Level 2 (Average Maintenance)

Medium use areas such as cemeteries, maintenance compounds, play areas, monuments, campgrounds, beaches and athletic fields - (finished mowing height 60 - 75 mm (2 1/2 - 3"))

Level 3 (Minimum Maintenance)

Low use areas such as roadsides, sewage lagoon sites, community fringe/transition areas and vacant properties - (finished mowing height - approximately 80-130 mm (3 - 5")).

10.2.5 Turf Management

Turf Management shall be:

- in accordance with designated level of service guidelines;
- to control undesired weed growth;
- to improve soil condition and fertility; and
- to promote healthier and more uniform growth/coverage.

10.2.6 Plant Material Maintenance

Plant material shall be:

- protected from abuse;
- maintained to encourage normal healthy growth;
- pruned as required to remove dead, dangerous or diseased growth;
- pruned to achieve desired shape (hedge) or function (fruit tree); and
- free of wounds or painted with pruning tar as required.

10.2.7 Tree Removal

Tree removal shall be executed when a dying, dead, blown over or living tree presents a hazard. The removal process shall:

- adhere to safe felling procedures;
- eliminate hazard to people, traffic and property;
- permit safe passage;
- be timely and neatly executed; and
- be used to control certain tree diseases.

10.2.8 Walks and Hard Surface Areas

Walks and hard surface areas shall be:

- well graded and conform to original lines and grades;
- intact, firm and free of settlement or heaving;
- clean and free of trash and debris;
- sloped to allow for drainage - or be pervious to allow for natural percolation of rain water; and
- safe for intended public use.

10.2.9 Site Furniture Items

Outdoor site furniture shall be:

- maintained to encourage normal use and function;
- structurally safe;
- free of operating defects and missing components; and
- kept clean and presentable in appearance.

10.2.10 Site Restoration Activities

Where minor site restoration works are required, they shall:

- repair damage to the original state;
- improve the use of an area;
- provide for better drainage;
- make subsequent maintenance easier;
- reduce unwanted weed/brush growth; and
- improve general appearance.

10.2.11 Ancillary Site Utility Items

Ancillary site utilities shall be:

- checked for proper working order;
- protected from adverse weather;
- maintained in safe operating condition; and
- according to all applicable codes.

10.2.12 Children's Play Areas

Children's play areas shall be:

- safe;
- adequately drained;
- free of litter or debris;
- protected from misuse;
- kept in functioning order; and
- maintained to encourage use and enjoyment by children.

10.2.13 Sports Areas And Athletic Fields

Sports areas and athletic fields shall be maintained to:

- provide adequate outdoor areas for recreational purposes;
- provide safe, neat and well drained activity area surfaces;
- provide proper layout markings and related accessories;
- provide ice on maintained outdoor hockey rinks; and
- provide for snow removal on maintained rinks.

10.2.14 Waterfront Areas and Erosion Control Edges

Waterfront areas and edges shall be:

- maintained to provide desired function;
- kept clean and free of litter and debris;
- restored to control unwanted erosion; and
- kept in safe operating condition and according to applicable codes.

10.2.15 Unique Areas

Cemeteries, monuments and other unique areas shall be:

- maintained in a visually presentable state;
- kept free of damage from natural or human disruption; and
- repaired as the need arises.

10.2.16 Tourist Related Areas

Income producing/tourist related areas shall be maintained to:

- support business objectives;

- achieve user satisfaction;
- encourage repetitive use;
- meet locally appropriate competitive standards; and
- meet basic user/client/tourist trade expectations.

10.2.17 Site Related Lighting System

The major objectives for the site related lighting system are:

- a. To provide the public a measure of safety in exterior environments.
- b. To provide a measure of security and be a deterrent to vandalism in exterior environments.
- c. To provide night-time visibility for outdoor tasks, activities, decorative facilities and signs.

The level-of-maintenance for the site related lighting system shall be in accordance with the following:

- a. The lighting system to meet Canadian Electrical Code, latest revision, and related Provincial amendments.
- b. The designed lighting levels shall be maintained.
- c. Tree foliage that limits the amount of light shall be trimmed or the lights relocated.
- d. Hand holes on poles shall have covers securely attached.
- e. Electrical ground resistance of luminaires and metal lighting standards shall not exceed 10 ohms.
- f. The supply transformer operating voltage under load shall be set as close as practical to lamp rated voltage.
- g. The voltage drop at the last fixture in a lighting circuit shall not exceed 3% of the transformer supply voltage under load.

h. Burnt-out lamps shall be replaced with lamps of the same wattage and type.

i. Lighting control devices such as time switches and photocells shall operate to optimize the use of energy and life of the system, consistent with operational requirements.

j. Lighting fixtures shall be cleaned to ensure the quality of light emitted does not deteriorate beyond acceptable levels.

k. The structural integrity of the lighting system shall be maintained.

l. Street lighting should be included only in those areas where a central utility does not own and operate all the facilities. DIAND personnel should not be involved where the facilities belong to the utility. The utility will do the maintenance.

m. Lighting fixtures shall be protected against vandalism.

10.3 Roads

10.3.1 Culvert Maintenance

The major objectives for culvert maintenance are:

a. To keep culverts clean - free from debris - and functioning properly.

b. To ensure the flow of surface water running in natural streams, collected on the high side of the right-of-way, or running down the ditch line, under roads, streets or driveway entrances.

The level-of-maintenance for culvert maintenance shall be in accordance with the following:

a. Obstructions restricting the flow of water through culverts shall be removed as follows:

- Culverts shall be inspected, and debris removed if constricted by more than 25% during October and November prior to the winter season, and during April and May during the spring run-off.
 - Culverts shall, in addition, be inspected after heavy storms or periods of high run-off, and corrective measures taken if necessary.
 - During storms and floods, critical areas shall be patrolled and culvert inlets kept clear.
- b. Badly worn or broken culverts shall be repaired or replaced as soon as possible to minimize the possibility of damage to the road bed by water saturating the fill material.
 - c. Culvert aprons and head walls which are scoured or broken shall be repaired.
 - d. Damaged embankments at culvert inlets or outlets shall be repaired.

10.3.2 Roadside Litter Pickup

The major objectives for roadside litter pickup are:

- a. To keep the roadside and travelled surface in a clean and safe condition by removing unsightly and hazardous objects.
- b. To allow for maximum productivity in grass mowing.
- c. To help ensure proper operation of drainage courses.

The level-of-maintenance for roadside litter pickup shall be in accordance with the following:

- a. Hazardous debris such as cans, bottles, paper, animal carcasses, stones, branches that can be handled and other trash on the roadside or within the median shall be removed as required.
- b. Debris shall not be allowed to disrupt mowing operations or obstruct drainage ways.

- c. Debris shall not be allowed to accumulate on lightly travelled roads and thus encourage dumping.

10.3.3 Ditches

The major objectives for ditch maintenance are:

- a. To maintain the drainage system so as to control and remove surface water within the right-of-way limits and surrounding area.

- b. To prevent erosion of shoulders and side slopes.

The level-of-maintenance for ditch maintenance shall be in accordance with the following:

- a. Obstructions in the flowline shall be removed:
 - ditches shall be inspected and cleaned of debris if necessary during October and November prior to the winter season, and during April and May during the spring runoff;
 - ditch grade lines shall have a uniform fall and be free from obstructions or sudden drop-offs;
 - weeds growing in the ditch line shall be removed; and
 - brush and trees growing in the ditch line shall be cut.
- b. Ditches shall be filled where effective drainage has been accomplished by other means.

Ditch pavements, checks, rip rap, etc. should be maintained as designed.

10.3.4 Street/Road Cleaning

The major objectives for street/road cleaning are:

- a. To eliminate annoyances arising from street dirt.
- b. To prevent injuries to pedestrians, and damage to property and vehicles caused by loose objects being thrown up by traffic.

- c. To promote safety by removing debris which could cause skidding conditions.
- d. To reduce the obscuring of pavement markings and to prolong the life of these markings.
- e. To prevent the clogging of sewers.
- f. To enhance the appearance of the reserve/settlement.

The level-of-maintenance for street/road cleaning shall be in accordance with the following:

- a. Within reserves/settlements, roads shall be maintained in order to reduce the accumulation of dirt and debris.
- b. Outside of reserves/settlements, paved road surfaces shall be cleaned during the spring to remove winter abrasives.

10.3.5 Base and Subgrade Repairs

The major objectives for base and subgrade repairs are:

- a. To correct areas where adequate drainage has not been provided and damaging frost action or other detrimental effects, or water have occurred.
- b. To correct areas where the distribution of stresses created by traffic loads on the wearing surface have caused deformation and displacement of the surface.

The level-of-maintenance for base and subgrade repairs shall be in accordance with the following:

- a. Repairs shall be made when any of the following defects are observed:
 - surface areas heaved or depressed by frost action in the sub-grade material;

- depressions or cracks in the surface through which wet or muddy material is percolating; or
 - depressions in the surface causing the thrusting of base material onto the shoulder.
- b. Investigation and thorough study of the cause of base failure and corrective action should precede the repair work.
- c. Surface repairs shall be made to the same standard as the general surface.

10.3.6 Gravel Surfaces

The major objectives for maintaining gravel surfaces are:

- a. To provide a smooth, safe riding surface free from defects.
- b. To eliminate hazards to vehicular traffic.
- c. To protect the investment in the road surface.

The level-of-maintenance for gravel surfaces shall be in accordance with the following:

- a. The causes of soft wet areas that move under traffic shall be eliminated or repaired.
- b. The causes of water lying on the surface or running across the surface shall be corrected.
- c. Rocks greater than 50 mm in diameter heaved to the surface by frost action or grading shall be removed.
- d. A crown with a crossfall of approximately 40 mm/m measured from the centre line to the edge of the road shall be maintained.
- e. On curves, the super elevation shall continue across the full road width.
- f. Gravel windrows at the outside edge of the road or at intersections shall be removed.

- g. The outside edge of the road surface shall be maintained flush with roadside grass.
- h. Windrows on the surface, or cuts and gouges across intersections caused by grading, shall be removed or corrected.
- i. Potholes in excess of 50 mm in depth shall be repaired.
- j. Washboard conditions (corrugations) with a depth greater than 30 mm between valleys and crests shall be corrected.
- k. Excessively dusty conditions shall be corrected by application of calcium chloride or other dust control products:
 - where the condition causes nuisance to residents; and
 - where the condition is hazardous to traffic.
- l. Excessively harsh stoney locations shall be corrected.
- m. Gravel shall be added to resurface gravel roads when there is general loss of surface material resulting in frequent breaks in the crust or a change in the surface composition (such as an excess of either fine or granular material).

10.3.7 Bituminous Surfaces

The major objectives for maintaining bituminous surfaces are:

- a. To provide a smooth, safe riding surface free from defects.
- b. To eliminate hazards to vehicular traffic.
- c. To protect the investment in the road surface.

The level-of-maintenance for bituminous surfaces shall be in accordance with the following:

- a. Cracks wider than 5 mm shall be sealed.

- b. Depressions or bumps greater than 30 mm over a distance of 3 m or less shall be corrected.
- c. Ruts or corrugations greater than 10 mm deep in the wheel paths shall be corrected.
- d. Surface alligatoring or checking shall be repaired. Conditions causing extensive areas of these deficiencies shall be investigated and corrected.
- e. The cause for water ponding to a depth greater than 10 mm shall be eliminated or repaired.
- f. Broken pavement edges, potholes, breaks or ravelled areas larger than 100 mm in diameter shall be repaired.
- g. Crossfall of pavement from the centre line to the edge of the pavement shall be uniform over the section of the road.
- h. Severe surface polishing causing excessively slippery conditions when wet shall be corrected.
- i. Bleeding surfaces constituting a hazard to the road user shall be corrected.

10.3.8 Roadside Tree, Brush and Weed Control

The main objectives of roadside tree, brush and weed control are:

- a. To maintain correct sight distances.
- b. To preserve safe vertical clearance and lateral recovery distance.
- c. To preserve the structural integrity of the roadway.
- d. To reduce or eliminate drifting snow conditions.
- e. To maintain the aesthetic appearance.
- f. To prevent the spread of noxious weeds.

The level-of-maintenance for vegetation consisting of trees, brush and weeds shall be in accordance with the following:

- a. Vegetation obscuring sight distance to traffic signals and signs or the view across the inside of curves, at intersecting roads or at road approaches, shall be cut back or removed.
- b. Vegetation on shoulders, in ditches and on slopes where it contributes to poor drainage shall be removed.
- c. Trees within the safe lateral travel distance shall be removed.
- d. Vegetation catching snow, forming drifts which contribute to icing conditions, shall be removed.
- e. Dead trees, or limbs that are diseased, weakened, unsound, undermined or leaning such that they might fall on or across the roadway shall be removed.
- f. Weeds and brush shall be eliminated under guard rails, at headwalls, sign posts, rip rap under bridges and grade separations, and on traffic islands and medians.

10.3.9 Roadside Grass Control

The main objectives for roadside grass control are:

- a. To improve vision.
- b. To improve the general appearance of the roadside.
- c. To reduce the need for weed and brush control.
- d. To reduce the effort required to maintain roadside ditches and shoulders.

The level-of-maintenance for roadside grass control shall be in accordance with the following:

- a. Mowing shall be scheduled so that complete sections of a road--between interchanges, major intersections, or structures--are completed before moving on.

b. The following areas shall not be cut under any level-of-service:

- cut and fill slopes steeper than 2:1 and deeper than 1.5 m,
- the top of a cut steeper than 2:1 and deeper than 1.5 m, and
- the area from the right-of-way line to the base of a fill higher than 1.5 m.

c. High fills with a guide rail or guide posts should be mowed so that the top of the grass is below the level of the outside shoulder edge.

d. Mow a minimum of 2.5 m wide where possible when grass reaches 20 - 25 cm.

e. Mow to a height of 7.5 - 10 cm.

NOTE: New grass shall not be mowed during the year in which it was planted.

10.3.10 Bridge Maintenance

The major objectives for bridge maintenance are:

- a. To provide safety to the user through preventive maintenance.
- b. To protect the investment in structures.

The level-of-maintenance for bridge maintenance shall be in accordance with the following:

- a. Exposed metal surfaces on structures shall be kept free of rust.
- b. Damage to structures resulting from traffic accidents or deterioration shall be repaired and/or damaged sections replaced.
- c. Accumulations of excess amounts of debris under a bridge should be removed and any evidence of scouring should be investigated by a qualified engineer.

- d. Bridge decks, expansion joints and bearings should be cleaned and flushed to remove sand and other debris.
- e. Structural components which show visual deterioration should be examined in detail by a qualified engineer.

10.3.11 Curbs and Gutters

The major objectives for maintaining curbs and gutters are:

- a. To facilitate the removal of surface water from the wearing surface.
- b. To prevent water from spilling over and eroding side slopes.
- c. To protect lawns and sidewalks from vehicles.

The level-of-maintenance for curb and gutter maintenance shall be in accordance with the following:

- a. Curb and gutter sections which have settled or heaved by more than 50 mm shall be reset if possible.
 - Investigation and thorough study of causes shall precede repair work.
 - If resetting is impossible, sections shall be reconstructed.
- b. Curb gutter sections with spalled areas or damaged sections of 70% to 100% in a length of 3 m shall be repaired.
- c. Holes or gouges deeper than 30 mm shall be repaired.

10.3.12 Signs

The major objectives for maintaining signs are:

- a. To control, safeguard and expedite traffic.
- b. To provide information as to highway routes, directions, road/street destinations and points of interest.

The level-of-maintenance for signs shall be in accordance with the following:

a. All broken, damaged, defaced, weathered or fallen signs, as listed below, shall be replaced or repaired as soon as possible where other than normal conditions exist:

- detour signs and/or flashers - if a hazard exists or major disruption to traffic would occur;
- warning signs such as "Detour Ahead", "Keep Right" placed on a physical obstruction or other extreme hazard;
- general - any sign damage that presents a hazard to traffic;
- Stop;
- Yield;
- one way arrow; and
- one way Do Not Enter.

b. All broken, damaged, defaced, weathered or fallen signs, as listed below, shall be replaced or repaired as soon as possible during normal working hours:

- regulatory signs not covered above, such as turn prohibitions, speed zones, etc.;
- detour signs - miscellaneous signs not covered above;
- pedestrian signs - "School Crossing" and "Playground" signs, etc.;
- warning signs - those showing minor curves in the road, signals ahead, etc.; and
- Guide signs - all.

c. Signing to be carried out as part of regular programs is listed below:

- all signs with incorrect wording and spelling shall be replaced;
- dirt and snow accumulation that impairs legibility of signs shall be removed;
- any obstruction of signs by structures, trees, brush or weeds shall be removed or the signs relocated;
- sign posts out of plumb by more than 2.5 cm in 60 cm shall be reset;
- signs that are off-level by more than 2.5 cm in 60 cm shall be relevelled; and
- all signs shall be mounted in accordance with the "Uniform Traffic Control Devices For Canada" manual.

d. Signs incorrectly placed shall be corrected.

e. Sign posts that project above the top of signs shall be corrected.

f. Missing, loose or defective bolts and fasteners on all signs shall be corrected.

g. Loose anchor bolts shall be tightened, sign structures appearing unsafe or having cracked foundations shall be repaired.

h. Sign posts and backs shall be cleaned and repainted as required.

i. Reflective signs should be tested for reflective qualities and replaced when they fail to meet established standards.

10.3.13 Guide Rail/Guide Posts

The major objectives for guide rail/guide post maintenance are:

a. To maintain these facilities so as to effectively serve as guides to vehicular traffic.

b. To define sharp curves, high fills, or other hazardous objects or locations.

The level-of-maintenance for guide rail/guide post maintenance shall be in accordance with the following:

a. Guide rails shall be aligned horizontally and vertically with the general line of installation.

b. All posts shall be vertical, sound and solidly set in the ground.

c. All bolts shall be tight.

d. Painted steel beam guide rail shall be repainted when approximately 1/3 of the paint is missing from a run.

e. All damaged components shall be replaced.

f. All tops of posts in a run shall have uniform angle cuts.

g. Cables shall be maintained at the designed tension.

h. Posts shall be repainted when 1/3 of the paint is missing from a run.

i. Reflective strips shall be clean and in good condition on every third post on curves and on each end post and every fifth post on tangents and straight runs.

j. Delineators should be installed in accordance with "Uniform Traffic Control Devices For Canada" manual.

k. Delineators and guide posts shall not be out of plumb by more than 8 cm.

10.3.14 Winter Operations

The major objectives for winter operations are:

a. To reduce the hazards of icy road conditions for motorists.

b. To facilitate the handling of emergencies by fire and police officers.

c. To maintain safe, passable winter routes.

10.3.15 Snow Fence Erection and Removal

The major objective for erection of snow fences is:

To trap drifting or blowing snow and deposit it on the ground surface before it accumulates on the roadway.

The level-of-maintenance for snow fence erection and removal shall be in accordance with the following:

a. Snow fences shall only be installed where abnormal drifting occurs.

b. Snow fences shall be erected in October and November.

c. Posts shall be spaced evenly approximately 3 m apart in a straight line and at a uniform height to the top of the posts. The posts shall be driven a minimum of 60 cm into the ground.

d. Fences shall be placed on the prevailing upwind side of the posts and fastened to the rail and posts with three tie wires.

e. Fences shall be erected so that the bottom of the wooden laths are from 7.5 to 15 cm above the ground.

f. Fences shall be stretched tight enough to prevent excessive sag (not more than 5 cm).

g. Posts shall be braced with guy wires and steel brace posts at the ends and at 45 m intervals.

Snow fence removal shall be in accordance with the following:

a. Snow fences shall be removed during April and May.

b. Repairs required to snow fences shall be made while they are still in place.

10.3.16 Road Lighting System

The major objectives for the lighting system are:

a. To provide pedestrians and motorized vehicle operators with a measure of safety in exterior environments.

b. To provide a measure of security, and be a deterrent to vandalism in exterior environments.

The level-of-maintenance for the road lighting system shall be in accordance with the following:

a. The lighting system is to meet Canadian Electrical Code, latest revision and related provincial amendments.

b. The designed lighting levels shall be maintained.

c. Tree foliage which limits the amount of light on walkways, roads, etc. shall be trimmed or the lights relocated.

d. Hand holes on poles shall have covers securely attached.

e. Electrical ground resistance of luminaires and metal lighting standards shall not exceed 10 ohms.

f. The voltage drop at the last fixture in a lighting circuit shall not exceed 3% of the circuit supply voltage under load.

g. Burnt-out lamps shall be replaced with lamps of the same wattage and type.

h. Lighting control devices such as time switches and photocells shall operate to optimize the use of energy and the life of the system, consistent with operational requirements.

i. Lighting fixtures shall be cleaned to ensure the quality of light emitted does not deteriorate beyond acceptable levels.

j. The structural integrity of the lighting system shall be maintained.

k. Responsibility for street lighting maintenance should be included only in those areas where a central utility does not own and operate all the facilities. DIAND personnel should not be involved where the facilities belong to the utility. The utility personnel will do the maintenance.

l. Burnt-out lamp replacement to be completed within 24 hours of notification for partial lighting (isolated fixtures).

m. Lighting fixtures shall be protected against vandalism.

n. The supply transformer operating voltage under load shall be set as close as practical to the lamp rated voltage.

10.4 Fire Protection

10.4.1 Systems

10.4.1.1 General Remarks

The major objectives for fire protection system maintenance are:

- a. To protect human life.
- b. To keep the fire protection system operative.
- c. To alert the fire brigade.
- d. To protect the initial capital outlay invested in structures and services.

The level-of-maintenance for fire protection system maintenance shall be in accordance with the following:

10.4.1.2 Fire Alarm (Intrusion) Systems

Fire alarm systems shall be in accordance with the following:

- a. The system shall be free of defects such as open and short circuits in conductors, faulty boxes or warning devices, etc.
- b. Stand-by power shall be at nominal voltage and full capacity at all times.
- c. Fire alarm box mechanisms shall be cleaned and adjusted to manufacturer's instructions.
- d. The glass cover enclosing the trip lever of the fire alarm box shall be intact, ready for alarm activation.
- e. Resistance of grounded circuit components shall not exceed 25 ohms.
- f. Conductor insulation resistance when isolated from circuit components shall be at least one (1) megohm.
- g. Sag of overhead conductors and clearances from other services on the same pole line shall be for communication cables as allowed in CSA standard C22.3 No.1 (C.E. Cod Part 111).
- h. No broken or cracked conductor insulators shall be permitted on overhead lines.
- i. The main control panel shall be free of defective meters and indicating lamps.
- j. Tree trimming adjacent to aerial fire alarm conductors shall be to CSA Standard C22.3 No. 1 (C.E.C. Part IV).

10.4.1.3 Smoke Detectors

Smoke detectors shall be free of defects such as open and short circuits, faulty audible warning devices, etc.

10.4.1.4 Fire Extinguishers, Hose cabinets

Fire extinguishers shall be checked regularly to ensure performance if called upon.

10.4.1.5 Sprinkler System

The sprinkler system shall be checked regularly to ensure performance. Twice each year the system shall be totally checked by the Regional Fire & Safety officer (using his/her staff or a specialized contractor). See Task Statement 1500.4 for details.

10.4.1.6 Hydrants

Hydrants shall be in accordance with the following:

- a. A record shall be kept of the location of all hydrants.
- b. Hydrants shall have all parts intact.
- c. Flow through hydrants shall be free and unrestricted.
- d. Drains for emptying hydrant barrels shall be clear of all restricting sediment and free of water at all times.
- e. Exterior surfaces of hydrants shall be painted and clean.
- f. Hydrants shall be clear of snow during winter.

10.4.1.7 Fire Exits

Exterior fire escapes shall be inspected to ensure structural integrity. Interior and exterior fire escape routes shall be kept clear of litter and obstructions.

10.4.1.8 Fire Pump (part of a building system)

The fire pump shall be checked regularly to ensure performance if called upon.

10.4.2 Firefighting Apparatus

The major objectives for firefighting apparatus maintenance are:

To ensure that the apparatus is kept in top operating condition.

The level of maintenance for firefighting apparatus maintenance shall be in accordance with the following:

- a. The maintenance shall be performed in accordance with the operator's handbook furnished by the manufacturer.
- b. All valves and parts shall be cleaned and adjusted for leaks.
- c. All vehicle components: cab, chassis, wheels, tires, glass, etc. are to be inspected and/or adjusted.
- d. All vehicle electrical, cooling, braking and warning systems are to be tested and any deficiencies rectified.
- e. Upon completion of the inspection the vehicle and all systems are to be road tested.
- f. A written report shall be prepared by the fire chief or the engaged contractor and forwarded to the regional fire and safety officer upon completion of the check (report submission schedule to be established by the regional fire and safety officer).

10.4.3 Firefighting Equipment

The major objectives for firefighting equipment maintenance are to support the firefighting apparatus and suppression operations.

The level-of-maintenance for firefighting equipment maintenance shall be in accordance with the following:

- a. Check all portable extinguishers according to type, ensure their proper operation and sign the inspection tag or seal.
- b. Check hose loads for lay and proper length (total length of hose not to exceed the capabilities of the fire pump).

c. Ensure that all the required nozzles and equipment are properly located and fastened on the firefighting equipment.

d. Check breathing apparatus, making sure all line control valves operate easily and that gauges indicate an adequate supply.

e. Examine regulators and ensure two spare tanks are full and ready for use.

f. Check all emergency generating equipment including handlamps (flashlights).

g. Inspect and start portable engines or motor driven equipment.

10.5 Utilities

10.5.1 Water Supply System

10.5.1.1 General Remarks

The major objectives for water supply system maintenance are:

a. To maintain the water system to the original design specifications.

b. To provide consumers with water that conforms to the federal and provincial government's standards on potable water quality.

c. To provide an adequate water supply for fire protection purposes.

The level-of-maintenance for water supply system maintenance shall be in accordance with the following:

10.5.1.2 Water Mains

Water mains shall:

a. maintain a satisfactory degree of water tightness;

NOTE: for various pipe materials and pressures there are established allowable leakages for newly installed mains. It is assumed that this allowance has not been exceeded in the original installation. A satisfactory degree of water tightness shall therefore not exceed the original leakage allowance by more than 10%.

- b. deliver the fire flows which satisfy the requirements of the Fire Commissioner of Canada; and
- c. not degrade the quality of water by imparting rust, organic matter or undesirable odours, tastes and colour.

10.5.1.3 Valves

For valves:

- a. the valves shall be capable of being fully operational (open, close, tightness);
- b. valve indicators shall be clean and easily visible; and
- c. valve boxes shall be clean and set at a proper grade and angle.

10.5.1.4 Meters

Meters shall:

- a. be maintained to statutory requirements;
- b. not leak; and
- c. have no damage which impairs their operation.

10.5.1.5 Water Pumps

- a. water pumps shall not leak beyond acceptable tolerances;
- b. the pumphouse pressure and section lines and fittings shall not leak;
- c. pumping equipment shall be fastened securely to solid platforms;

- d. float control components shall operate as required;
- e. standby pumps without automatic alternators shall operate efficiently on demand; and
- f. electrical pump components shall be clean and operable.

10.5.1.6 Concrete Reservoirs, Elevated Tanks and Standpipes

Consider the following:

- a. Water storage facilities shall not leak.
- b. Water reservoirs, tanks and standpipes shall be free of organic growth on interior wall surfaces, and sludge on bottom surfaces.
- c. Exterior surfaces shall be clean and attractive and free of rust, scale or peeling and chipped paint.
- d. Water-level controls shall be free of rust, dirt, scale, etc.
- e. Structural integrity shall be maintained.

10.5.1.7 Wells

Well water shall meet at least the desirable levels prescribed in the federal Government's "Guidelines for Water Quality Objectives and Standards".

10.5.1.8 Chlorinators

Consider the following:

- a. Hypochlorinators shall be capable of constant and accurate application of chemical treatment.
- b. Any contaminated parts or deposits from hypochlorite solution shall be removed from the equipment and work area.
- c. All safety precautions required by the statutory authority for operation of gas chlorinators must be carried out.

d. Gas chlorinators shall be capable of constant and accurate application and disinfection.

e. Strainers shall be clear of blockages.

10.5.1.9 Water Softeners and Filtration Equipment

Water softeners and filtration equipment shall:

a. provide treated water within the limits established by the federal governments' "Guidelines for Water Quality Objectives and Standards"; and

b. be maintained according to the manufacturer's recommendations.

10.5.2 Wastewater Systems

10.5.2.1 General Remarks

The major objectives for wastewater system maintenance are:

a. To protect the capital investment.

b. To ensure that effluents from wastewater treatment meet federal and provincial quality standards.

The level-of-maintenance for wastewater system maintenance shall be in accordance with the following:

10.5.2.2 Sanitary, Storm and Combined Sewers and Sewer Service Pipe

Consider the following:

a. Sewer pipe must be whole, with no collapsed sections.

b. The infiltration rate of groundwater into sewer pipes between two adjacent manholes must not exceed 1% of the volume per hour of the sewer main under test.

c. Service connection fittings must not protrude into a sewer main.

- d. Sewer outfalls must be whole and structurally sound.
- e. Sewer pipes must be free of all solids larger than 15% of the sewer pipe's cross sectional area.
- f. Silt, sludge and other similar deposits in sewers must not accumulate in the invert of a sewer to a depth greater than 15% of the sewer diameter.

10.5.2.3 Manholes for Sanitary, Storm and Combined Sewer Mains

Consider the following:

- a. Manholes must be structurally sound.
- b. Not more than 5% of the concrete surface shall display exposed reinforcing steel.
- c. Manhole bricks must not be worn, scaled or spalled by more than 25% of the original thickness of the brick manhole wall.
- d. Manhole rungs must support a vertical load of 225 kg without deformation.
- e. Manhole walls and floors must be clean and free of dirt, silt, slime and sludge.
- f. The tops of manhole frames and covers in a roadway must be less than 30 mm below the road surface, when measured with a 3 m straight edge.
- g. Manhole frames and covers must be quiet when run over by rubber-tired vehicles.
- h. Manhole frames and covers must not be broken or cracked.
- i. The maximum total infiltration of groundwater through the walls and footings of a sanitary sewer manhole must be less than 5 L/h.
- j. The maximum total infiltration of groundwater through the walls and footings of a storm sewer manhole must be less than 10 L/h.

k. Where possible, manholes for systems that are not designed to carry water away should be above the surrounding land to avoid surface water infiltration.

10.5.2.4 Catchbasins

Consider the following:

- a. Catchbasins must be structurally sound and safe.
- b. The top of catchbasin frames and covers in a roadway gutter should be more than 10 mm and less than 50 mm below the gutter surface, when measured with a 3 m straight edge along the gutter.
- c. Catchbasin frames and covers must be quiet when run over by a rubber-tired vehicle.
- d. Not more than 5% of the concrete surface shall display exposed reinforcing steel.
- e. Catchbasin bricks must not be worn, scaled or spalled by more than 25% of the original thickness of the brick catchbasin wall.

10.5.2.5 Pumping/Lift Stations

Consider the following:

- a. All equipment must be maintained as stated by the equipment manufacturer.
- b. Bearings must run quietly.
- c. Motors must run within 1% of nameplate speed.
- d. Pumps must operate quietly.
- e. Packing glands must not leak more than one drop per second.
- f. Anchor bolts for equipment must be tight.
- g. All floats for controls must be clean and free of all debris.
- h. Liquid-level electrodes must be clean.

- i. All visible pumps and equipment must be kept clean and well painted.
- j. The floors must be clean and free of any parts or material in storage.
- k. The wet wells of sewage pumping stations must not have more than 10% of the liquid storage capacity occupied by silt, sludge or other settled solids.
- l. The flap mechanism in check valves must have free movement.
- m. Pump impellers must rotate freely with the pump shaft.
- n. Float-type mercury switches must be clear of floating or settled debris.

10.5.2.6 Holding Tanks

Consider the following:

- a. Liquid-level controllers, indicators or alarms at holding tanks must function freely and effectively.
- b. Tanks must not leak.
- c. Tank surface coatings, which prevent or retard corrosion, must completely cover the surface and be free from punctures.
- d. Tanks must not overflow.
- e. Odour levels shall be minimized.

10.5.2.7 Septic Tanks and Disposal Fields

Consider the following:

- a. The sludge in the septic tank must be more than 50 cm from a scum baffle.
- b. Floating scum in a septic tank must be more than 8 cm from the bottom of the scum baffle.

- c. Do not disinfect septic tanks after removing the sludge or total contents.
- d. Tile fields for ground disposal of septic tank liquid should be free of plant roots which might block the waste flow in the tiles.
- e. Surfaces should be grassed; free from ponding water and protected from all traffic.
- f. Tile subsurface disposal fields in northern areas should be covered in the fall with straw, bales or branches to hold the snow cover during the winter.
- g. Air vents should be protected.

10.5.2.8 Wastewater Stabilization Ponds

Consider the following:

- a. Effluents shall meet provincial and federal government wastewater treatment quality standards.
- b. Berm slopes must be smooth, well trimmed and free of burrowing animals.
- c. Grass on exterior berm slopes must be no taller than 30 cm.
- d. The perimeter fence for wastewater treatment ponds shall have a gate, which opens freely without lifting, and a lock.
- e. Warning signs at wastewater treatment facilities shall be legible and unobstructed.
- f. Valves located in valve chambers shall be well painted and have clean surfaces and operating wheels.
- g. If more than 15 cm of soil has eroded from a berm, it must be replaced to match the original design specifications.
- h. Rip-rap must be placed, or replaced, if more than 15 cm of soil has eroded more than once in three years.

- i. Vegetation on the interior berm slope shall be controlled without the use of herbicides or soil sterilant.

10.5.2.9 Mechanical Treatment Facilities

Consider the following:

- a. Effluents shall meet provincial and federal government wastewater treatment quality standards.
- b. Treatment facilities should be clean, neat and tidy.
- c. The odours emitted by treatment facilities should not be offensive or septic.
- d. Metal surface coatings which prevent or retard corrosion must completely cover the surface and be free from punctures.
- e. Mechanical equipment should be kept in proper working order.
- f. Pipes and air lines should be kept free from obstructions and accumulations of any sort.
- g. Sludge level must be maintained within the design criteria of the facility.
- h. Plant equipment shall be maintained in accordance with manufacturer's recommendations.
- i. The perimeter fence shall have a gate which opens freely without lifting, and a lock.
- j. Outlet structures must be structurally sound.

10.5.3 Solid Waste System

10.5.3.1 General Remarks

The major objectives for solid waste system maintenance are:

- a. To provide a hygienic and sanitary environment in populated areas.

- b. To provide a final disposal area for solid waste.
- c. To eliminate the attractiveness of solid waste to wildlife.
- d. To ensure that solid waste management systems meet federal and provincial quality standards.

The level-of-maintenance for solid waste system maintenance shall be in accordance with the following:

10.5.3.2 Solid Waste Collection

Consider the following:

- a. Solid waste shall be stored in suitable containers and enclosures for pick-up.
- b. Empty containers shall be returned to designated areas and correctly set up.
- c. Disposal methods at incinerator or landfill sites shall not leave solid waste scattered around the disposal site.

10.5.3.3 Solid Waste Disposal

Consider the following:

- a. Landfill sites shall be covered with soil and compacted every day that dumping occurs.
- b. Refuse should not be permitted to be deposited in locations where contact occurs with refuse and the water table.
- c. Perimeter fences should prevent the spreading of paper.
- d. Incinerators should be cleaned out to provide adequate capacity for incoming solid waste.
- e. Equipment shall be maintained in accordance with manufacturers' recommendations.

f. Disposal of solid waste shall be in accordance with federal and provincial standards.

10.5.4 Electrical Power Generation/Distribution System

10.5.4.1 General Remarks

The major objectives for electrical power generation/distribution systems are:

- a. To maintain departmental electrical power supply and distribution facilities to meet the standards of the provincial power authority and Canadian Electrical Code (latest edition) with applicable provincial amendments.
- b. To provide continuous departmental interruptible power to facilities approved by the design authority.
- c. To ensure that connections from distribution systems to facilities are made only by the power authority.
- d. To permit the supply of power only to facilities that have been inspected and approved by the power authority.
- e. To advise provincial/territorial utility supply authorities of any deficiency in their electrical system and request correction of the problem to meet provincial standards/DIAND agreement.

The level-of-maintenance for departmental electrical power generation/distribution systems shall be in accordance with the following:

10.5.4.2 Primary Power Generation

Consider the following:

- a. Automatic air louvres shall function to stabilize engine temperature within the normal operating range.
- b. Generated voltage from diesel generator supply, and frequency variations under load, shall be within the manufacturer's specifications.

- c. The load of the diesel generator shall not be less than 50% of name plate capacity. Dummy loads shall be used to increase the load where required.
- d. Line currents shall be balanced within 10% of the maximum value and shall not exceed the overload rating specified. A balancing check is to be carried out every 3 months at generator supply.
- e. Alternate the prime source and stand-by unit on a regular basis to equate running hours.
- f. Where a new stand-by unit is installed with an older unit, run new unit 75% of time to optimize running hours during the warranty period, then alternate on a regular basis.
- g. Maintain the engine generator set according to manufacturer's recommendations.
- h. Oil and coolant levels shall be normal.
- i. Battery electrolyte shall be at normal levels and no corrosion shall appear at terminals.
- j. Fuel leaks shall be corrected.
- k. The day fuel tank shall be full after each test run period.
- l. The engine generation room shall be kept at 10°C minimum, between running periods.
- m. Maintain engine generator set according to manufacturer's recommendations.

10.5.4.3 Primary Overhead Distribution Systems

Consider the following:

- a. Qualified personnel only shall perform actual maintenance.
- b. Warning signs required by the C.E. Code Part 1 Section 36 shall be legible and unobstructed.

- c. The rating of overcurrent protection shall not exceed that prescribed by the C.E. Code for the protected device. Conductor clearances with other systems and to ground shall not be less than required by CSA standards of C22.3 No. 1 (C.E. Code Part 111).
- d. Tree trimming adjacent to overhead lines shall be to CSA standard C22.3 No. 1 (C.E. Code Part 111).
- e. Fallen trees shall be removed from overhead lines, and damage corrected.
- f. A potential source of power interruption is insulator contamination due to salt and dust-laden air, particularly in coastal areas and adjacent to salted highways. Insulator washing may be required. Follow applicable power supply authority procedure for systems of similar location and same operating voltage.
- g. Hardware is considered to be in good condition if the original finish (galvanize etc.. at the point of connection or mounting is intact, without evidence of rusting.
- h. Replacement poles shall meet the requirement of C.S.A. standards for new line construction, and shall be preservative treated as required by C.S.A. standards for the type of wood.
- i. Where approved techniques by the local power supply authority are used to enhance life of in-situ poles, such as the application of additional butt preservative treatment, consider the practice for our facilities.
- j. Replacement lighting arrestors shall be of the type that provides a positive indicator of arrestor failure by automatic isolation of ground conductor.
- k. Transformer oil shall conform to C.S.A. standard C50-1965, transformer oil shall be tested to C.S.A. standard C2-1969.
- l. Transformers shall not be overloaded except as permitted by A.N.S.I. guide for loading oil immersed

distribution and power transformers C67.91 1969 and February, 1971,, or alternatively as recommended by the transformer manufacturer's loading curve.

m. Ensure the rupturing rating and controls of the equipment are capable of withstanding the short circuit capacity of the system.

n. Transformers and capacitors utilizing P.C.B. (polychlorinated biphenyls), also known as askarels, as insulating fluids, are to be removed from service and replaced. When disposing of such transformers HQ is to be consulted to ensure safe disposal procedures.

10.5.4.4 Primary Underground Distribution Systems

Consider the following:

a. For terminal poles the following considerations apply:

(1) Lack of proper lightning protection for underground cable at terminal poles is a major factor in premature cable failure. Therefore, properly matched lightning arrestors are required on all terminal poles. Arrestors shall have a positive indication of failure by automatic isolation of the ground conductor.

(2) Blown fuses shall be replaced with the original kind as approved by the inspection authority, sized to protect the cable.

(3) Cable potheads shall not leak insulating compound.

(4) Stress cones at the cable termination shall have no evidence of insulation breakdown due to surface tracking of current to ground, as may be indicated by breaks, cracks or discolouration of insulation. Ground resistance of the stress cone shall not exceed 10 ohms.

b. Voltage drop at supply side of the service entrance equipment shall not exceed 2% of nominal system utilization voltage. Nominal system voltages are listed in Rule 8-100 C.E. Code Para. 1.

10.5.4.5 Secondary Overhead and Underground Distribution Systems

Consider the following:

- a. Voltage drop at supply side of service entrance equipment shall not exceed 2% of nominal system utilization voltage (voltage set from distribution transformer tap). Nominal system voltages are listed in Rule 8-100 C.E. Code Para. 1.
- b. Insulation quality of underground conductors operating at 600 volts and below is marginal and shall be replaced if insulation resistance falls below the minimum required by the C.E. Code Part 1, Table 24. Otherwise consider corrective action when a cable of a three or four wire system indicates a substantial difference in insulation resistance from the others, or if the readings show a substantial change compared with the previous test period.

10.5.4.6 Stand-by Power Generation

Consider the following:

- a. Operate stand-by power sets under full load for 1/2 hour on a regular basis. In critical areas one hour is preferred.
- b. Automatic air louvre shall function to stabilize engine temperature within normal operating range.
- c. Generated voltage from diesel generator supply and frequency variations under load shall be within manufacturer's specifications. Line currents shall be balanced at the generator within 10% of the maximum value and shall not exceed the overload rating specified.
- d. Balancing check to be carried out at every test period of diesel generator.