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Glossary of Terms

AADT	Annual Average Daily Traffic
API	Agency Performance Indicator
AWP	Annual Works Program
B/C	Benefit/Cost Ratio
BOC	Bureau of Construction
BOD	Bureau of Design
BOE	Bureau of Equipment
BOM	Bureau of Maintenance
BMC	Bridge Maintenance Costs
BMS	Bridge Management System
BNR	Bridge Needs Ratio
BRF	Bridge Route Factor
COE	Certificate of Exemption
CRF	Capital Recovery Factor
DPD	Development Planning Division
DPWH	Department of Public Works and Highways
ECC	Environmental Compliance Certificate
EDO	Engineering District Office
EMK	Equivalent Maintenance Kilometer
FAP	Foreign Assisted Project
FS	Feasibility Study
GAA	General Appropriations Act
GIS	Geographic Information System
IC	Intervention Cost
ICC	Investment Coordination Committee
IPRSD	Infrastructure Planning Research and Statistics Division
IQL	Information Quality Level
IRR	Internal Rate of Return
IT	Intervention Type
JBIC	Japanese Bank for International Cooperation
JICA	Japanese International Cooperation Agency
KPI	Key Performance Indicator
LFP	Locally Funded Project
LRM	Locational Referencing Method
LRP	Locational Reference Point
LRS	Locational Referencing System
MIS	Monitoring & Information Service
MM	Major Maintenance
MPS	Maintenance Priority Score
MTIDP	Medium Term Infrastructure Development Plan
MTPDP	Medium Term Philippine Development Plan
MTPIP	Medium Term Public Infrastructure Plan
MVUC	Motor Vehicle User Charge

MWP	Multi-year Work Program
MYPS	Multi-Year Program and Scheduling
ND	Network Development
NMPS	Normalized Maintenance Priority Score
NPV	Net Present Value
NPV/C	Benefit Cost Ratio
OIC	Officer In Charge
PMO	Project Management Office
PPI	Process Performance Indicator
PS	Planning Service
PS	Priority Score
PWF	Present Worth Factor
QA	Quality Assurance
QC	Quality Control
RBIA	Road and Bridge Information Application
RDBL	Road Diagram and Bridge List
RIMSS	Road Information and Management Support System
RMMS	Routine Maintenance Management System
RO	Regional Office
RODD	Regional Office Design Division
ROMD	Regional Office Maintenance division
RPO	Road Program Office
SQL	Standard Query Language
SRSF	Special Road Support Fund

BRIDGE MANAGEMENT SYSTEM
OPERATION PROCEDURES

1 OPERATION PROCEDURES INTRODUCTION

1.1 Background

A Bridge Management System (BMS) has been established within the DPWH to provide a computer based system for the management of Philippine national bridges. The process design and application developed provide an analytical tool that will enable the DPWH to monitor the state of the national bridges and to establish a rational and defensible case for specific funding for bridge asset preservation and major maintenance funding.

1.2 Scope of This Document

The BMS Operation Procedures include the procedures, which should be followed for implementing BMS process in the DPWH. These procedures should be taken as best practice to carry out certain functions.

The procedures included in this document are widely referred to various user guides and manuals for BMS implementation. Hence, other BMS documentation may require updating if any changes to these procedures are made.

1.3 Procedure Number

A procedure is generally referred by an identification number. The numbers of various activities of the BMS process design are taken as the relevant procedure identification number. It will assist to relate these procedures to the relevant block of the process design flow diagram.

The procedures based on the BMS Process design are grouped into:

- Annual Bridge Collection Survey (A1*)
- Operating BMS (A2*)
- Engineering Inspections (A3*)
- BMS Reporting (A4*)

1.4 Updating of Procedures

The BMS Operation Procedures comprise a best practice guide to implement the BMS. As with any best practice guide, the BMS process will be refined with time. Some of the procedures will need to be refined as well. To ensure that the latest version of each procedure will be used, a version control has been implemented. Appendix A contains the latest versions of various procedures and their effective date. The BMS Manager will be responsible for the version control of the procedures related with BMS.

2 BRIDGE DATA COLLECTION PROCEDURES

2.1 Overview

Annual bridge condition inspection (Type 3) data for all national bridges is required to enable the BMS to fulfill its function of managing the national bridges.

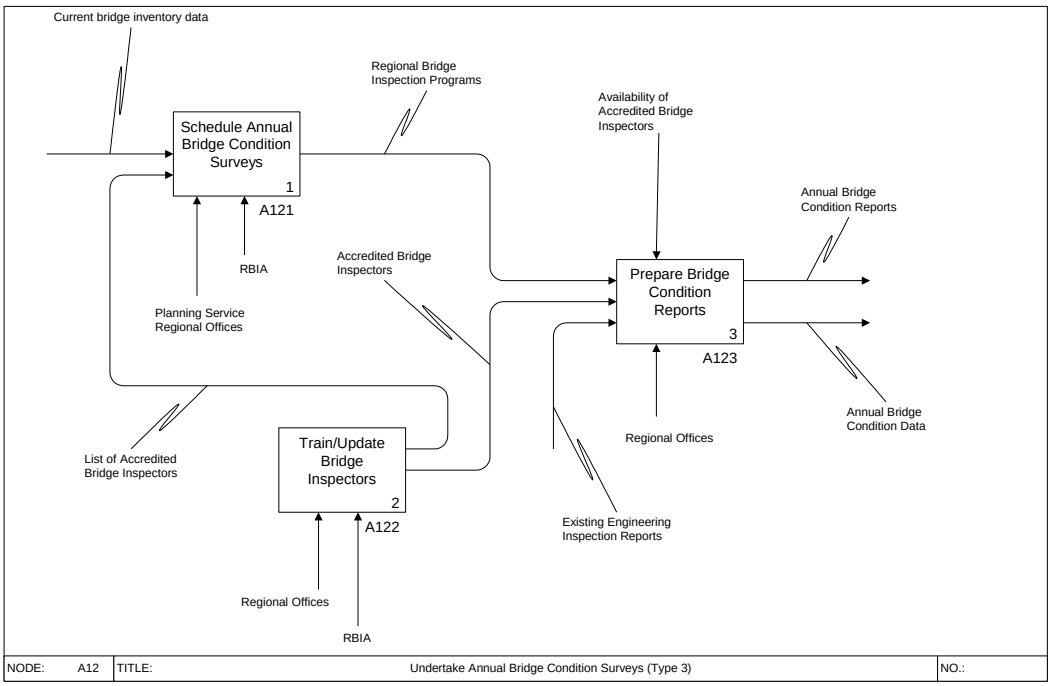
The importance of accurate and consistent data from the annual bridge condition inspection survey cannot be overstated. This is stressed by the number of procedures devoted to bridge data collection.

The bridge data collection procedures consist of three procedures as follows:

- Schedule Annual Bridge Condition Surveys,
- Train/Update Bridge Inspectors, and
- Prepare Bridge Condition Reports.

The relationship between these procedures is shown in Figure 2-1.

Figure 2-1
Bridge Data Collection Procedures



2.2 Procedure A121 - Schedule Bridge Condition Survey

2.2.1 Objective

The briefing of the Regional Offices for the Annual Bridge Condition Survey and the planning of the Annual Bridge Condition Survey to ensure that the Annual Bridge Condition Survey is completed efficiently to a high standard.

2.2.2 Definitions

Condition Inspection	Bridge inspection to determine the condition of a bridge based on assessment of defined attributes.
Annual bridge condition inspection program	The annual survey to collect condition data on all national bridges.

2.2.3 Application User Coordinator

Planning Service (PS) IPRSD

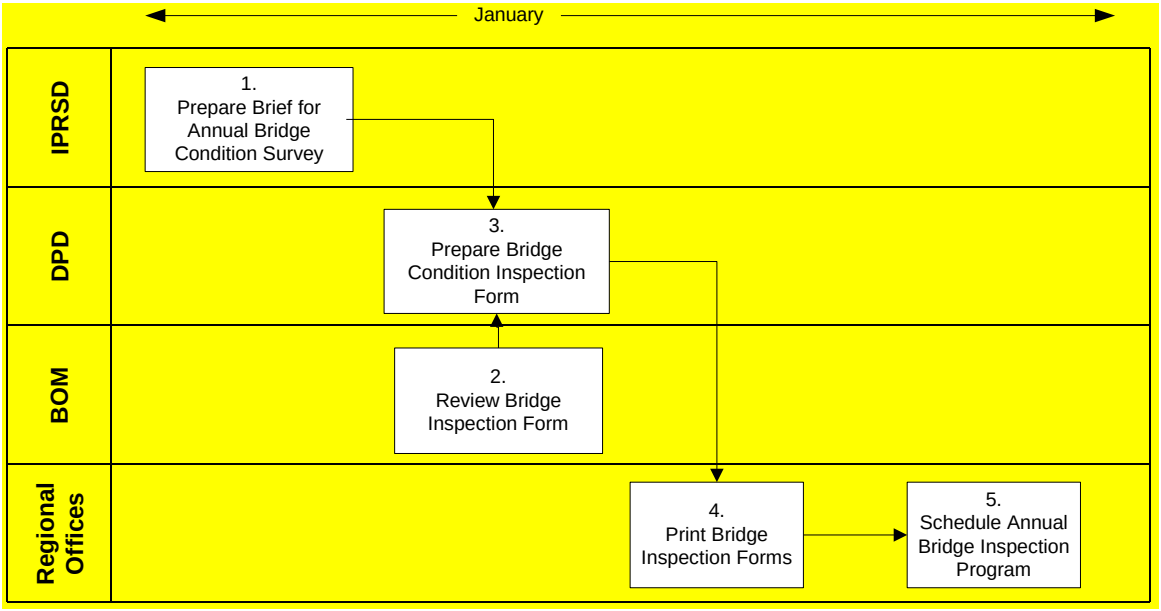
2.2.4 Users

Planning Service (PS) IPRSD
Bureau of Maintenance (BOM)
Regional Office Maintenance Divisions (ROMDs)

2.2.5 Workflow

The workflow for the process is included in Figure 2-2.

Figure 2-2
Workflow



Step 1 — Prepare the Brief for the Annual Bridge Condition Survey. The Brief will contain instructions to the DPWH Regional Offices to undertake the survey, and will include any additional notices on procedures or requirements for the undertaking of the survey.

Step 2 — Review Bridge Condition Inspection Form (Form BC_01)

Step 3 — Prepare revised Bridge Condition Inspection Form (Form BC_01)

Step 4 — Print Bridge Inspection forms for all bridges in the RBIA in each Region.

Step 5 — Schedule Annual Bridge Inspection Program.

2.2.6 Activities

Prepare Brief for Annual Bridge Condition Survey — The Brief will be prepared by the Planning Service IPRSD in consultation with the DPD BMS Team Leader and Bureau of Maintenance, and would contain all necessary information to enable the Regional Offices to complete the survey without any further assistance.

The Brief would contain the following sections:

- Instruction to commence the survey
- The program for the completion of the field survey
- Changes to the Condition Inspection Form
- Notes on issues with the previous survey
- Changes to the survey procedures and requirements
- Summary of procedures and requirements and reference to bridge inspection guidelines, manuals and training materials.

The Brief will be issued in January of each year to all Regional Offices.

Review Bridge Inspection Form (Form BC_01)

Bridge Inspection Manual Appendix E

The IPRSD will review the content and layout of the Bridge Condition Inspection (Type 3) Form and would design any necessary amendments to the form to reflect operating experience with the form, to allow for changed data collection items and to address any difficulties with the use of the form. The revised form will be incorporated into the BMS, following agreement with the BMS Team Leader on the revised form.

Print Bridge Inspection Forms

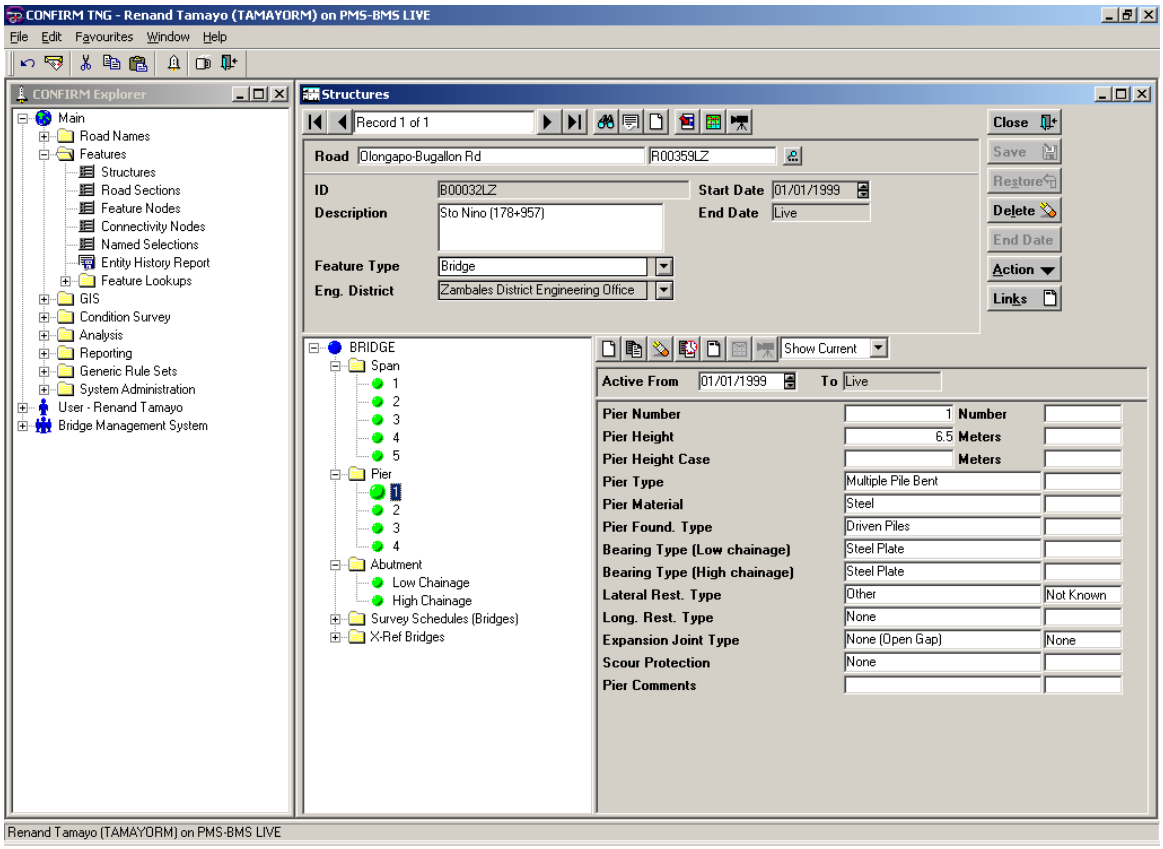
The Regional Offices will review the list of bridges included in the RBIA in consultation with the Engineering District Offices and verify that the bridge listing was accurate and complete for each Region.

The inventory of each bridge can be reviewed to check that the forms are correct. Refer Figure 2-3 for an inventory screen shot.

Bridge Inventory Reports:
BRDI_01
BRDI_02
BRDI_03
BRDI_04
BRDI_05

Alternatively, there are Inventory Reports that can be run to review the inventory.

Figure 2-3
Typical Bridge Inventory Review



RBIA Road Network Definition & Inventory Update Manual

The Regional Offices would arrange for the RBIA to be updated to allow for any modified or additional bridges (This process should occur throughout the year as such modifications are completed).

Bridge Data Collection Quality Assurance and Management Manual

Refer Table 2-1 for a typical bridge list printed from the RBIA, similar lists will be used to confirm the list of bridges in each region.

Table 2-1
Typical Bridge List

Cebu I, Region VII

Road Name	Road ID	Bridge Name	Bridge ID
Antonio y De Pio H-way	R00068CB	Soso Bridge (118+548)	B00005CB
Antonio y De Pio H-way	R00068CB	Luyang Bridge (119+865)	B00006CB
Antonio y De Pio H-way	R00068CB	Aningan Bridge (120+695)	B00007CB
Antonio y De Pio H-way	R00068CB	Poblacion Tabuelan Bridge (108+611)	B00014CB
Antonio y De Pio H-way	R00068CB	Olivio Bridge (113+507)	B00015CB
Antonio y De Pio H-way	R00068CB	Tacup Bridge (127+169)	B00016CB
Antonio y De Pio H-way	R00068CB	Lambusan Bridge (129+240)	B00017CB
Antonio y De Pio H-way	R00068CB	Tambongon Bridge (131+350)	B00018CB

Form BC_01

A Bridge Condition Form title page would be printed from the RBIA in the Regional Office for each bridge. The complete condition inspection form would be compiled using photocopies of the master form to suit the bridge configuration.

Report BI_02

A Bridge Inventory Summary Report would also be printed for each bridge from the RBIA.

Report BRE_02

Where an Engineering Inspection Report had been previously prepared for a bridge, a copy of the Engineering Inspection Report Summary Sheet would also be printed for use in the condition survey. The complete Engineering Inspection Report would also be made available to the Bridge Inspector for his/her information and use.

Typical documentation for a bridge condition inspection is illustrated in Figure 2-4.

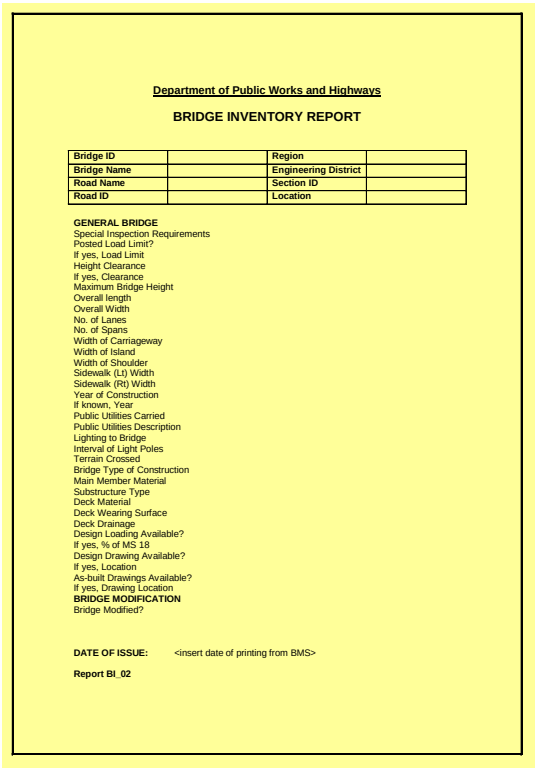
Schedule Annual Bridge Condition Program

The Regional Offices shall prepare an Annual Bridge Condition Inspection Program based on the available Accredited Bridge Inspectors and other required resources available in each Region. The Programs will include the use of bridge inspection vehicles to ensure that all bridges receive a complete inspection.

The location of bridges across each region shall be reviewed to assist in the planning of the bridge condition inspection survey in the region. The bridges shall be allocated to the available accredited bridge inspectors in the region with the number of bridges allocated to each inspector limited to ensure that all inspections can be done in the available time.

Refer Figure 2-5 for a typical GIS map that would be used for the allocation of bridge inspectors to bridges.

Figure 2-4
Typical Documentation for Bridge Condition Inspection



Department of Public Works and Highways

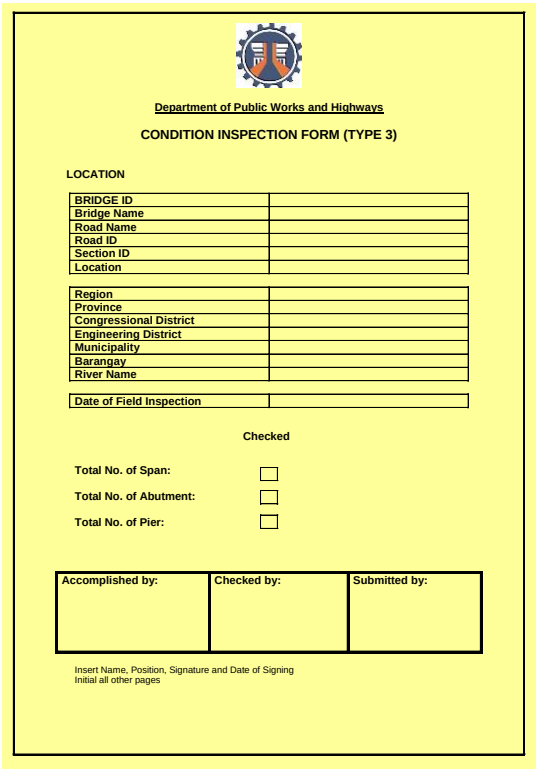
BRIDGE INVENTORY REPORT

Bridge ID		Region	
Bridge Name		Engineering District	
Road Name		Section ID	
Road ID		Location	

GENERAL BRIDGE
Special Inspection Requirements
Posted Load Limit?
If yes, Load Limit
Height Clearance
If yes, Clearance
Maximum Bridge Height
Overall length
Overall Width
No. of Lanes
No. of Spans
Width of Carriageway
Width of Island
Width of Shoulder
Sidewalk (Lt) Width
Sidewalk (Rt) Width
Year of Construction
If known, Year
Public Utilities Carried
Public Utilities Description
Lighting to Bridge
Interval of Light Poles
Terrain Crossed
Bridge Type of Construction
Main Member Material
Substructure Type
Deck Material
Deck Wearing Surface
Deck Drainage
Design Loading Available?
If yes, % of MS 18
Design Drawing Available?
If yes, Location
As-built Drawings Available?
If yes, Drawing Location
BRIDGE MODIFICATION
Bridge Modified?

DATE OF ISSUE: <insert date of printing from BMS>

Report BI_02



Department of Public Works and Highways

CONDITION INSPECTION FORM (TYPE 3)

LOCATION

BRIDGE ID	
Bridge Name	
Road Name	
Road ID	
Section ID	
Location	

Region	
Province	
Congressional District	
Engineering District	
Municipality	
Barangay	
River Name	

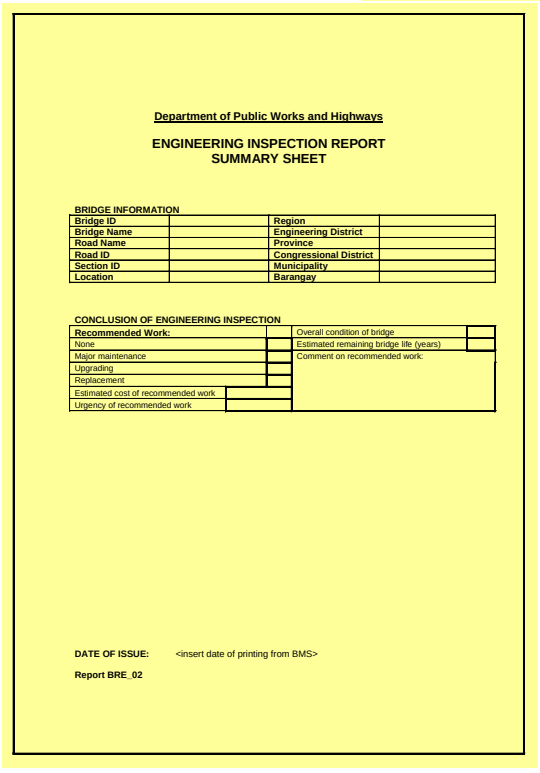
Date of Field Inspection	

Checked

Total No. of Span: ☐
Total No. of Abutment: ☐
Total No. of Pier: ☐

Accomplished by:	Checked by:	Submitted by:

Insert Name, Position, Signature and Date of Signing
Initial all other pages



Department of Public Works and Highways

ENGINEERING INSPECTION REPORT
SUMMARY SHEET

BRIDGE INFORMATION

Bridge ID		Region	
Bridge Name		Engineering District	
Road Name		Province	
Road ID		Congressional District	
Section ID		Municipality	
Location		Barangay	

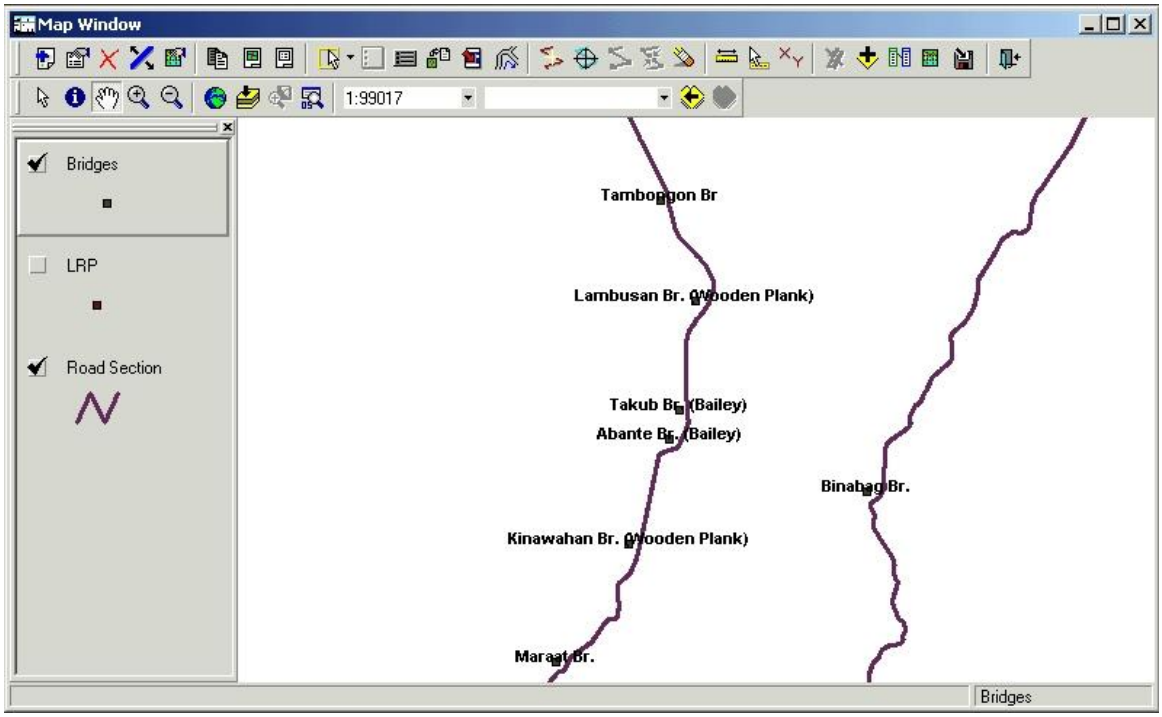
CONCLUSION OF ENGINEERING INSPECTION

Recommended Work:			
None		Overall condition of bridge	
Major maintenance		Estimated remaining bridge life (years)	
Upgrading		Comment on recommended work:	
Replacement			
Estimated cost of recommended work			
Urgency of recommended work			

DATE OF ISSUE: <insert date of printing from BMS>

Report BRE_02

Figure 2-5
Use of RBIA to Display Bridge Locations



The allocation of bridges will be made so that different bridge inspectors are assigned to each bridge each year. Unless the number of bridge inspectors is limited, each bridge inspector shall not inspect the same bridge more than once in a four (4) year period.

The availability of bridge inspection equipment will be reviewed to ensure that an equipment kit is available for each bridge inspection team. If necessary, additional bridge inspection equipment will be obtained.

The allocation of staff and vehicles will be arranged to ensure that the required number of bridge inspection teams, consisting of accredited bridge inspector, assistant and driver, are available for the field work as required by the Annual Bridge Condition Inspection Program.

The number of bridges requiring the use of bridge inspection vehicles will be reviewed and arrangements made for the provision of a bridge inspection vehicle for the required period to complete the survey of these bridges.

The inspection forms and other documentation for the bridges allocated to each bridge inspector will be compiled and issued to the bridge inspectors for implementation of the field survey.

A regional briefing session will be held for the issue of the forms, to be attended by all bridge inspectors, BMS Data Coordinator, BMS System Analyst, Regional Bridge Engineers and Maintenance Division IOC. The briefing session will review all aspects of the annual bridge condition survey and ensure that the bridge inspectors are prepared to undertake the survey.

2.3 Procedure A122 – Train/Update Bridge Inspectors

2.3.1 Objective

To ensure that each Region maintains a pool of accredited bridge inspectors to undertake the annual bridge condition inspection surveys to the necessary standard, and to provide a standard method for the assessment of existing and candidate bridge inspectors to ensure uniform bridge inspection practices throughout the Philippines, and the accreditation of bridge inspectors

2.3.2 Definitions

Accredited Bridge Inspector	An engineer or other professional bridge person who has undergone bridge inspection training and has been accredited to serve as a Bridge Inspector for a nominated period.
Instructor	An accredited bridge inspector appointed to provide bridge inspection training in a region.
Candidates	The regional and engineering district office staff selected to be trained and accredited as bridge inspectors.

2.3.3 Application User Coordinator

Bureau of Maintenance (BOM)

2.3.4 Users

Bureau of Maintenance (BOM)
Regional Offices (ROs)
Engineering Districts Offices (EDOs)

2.3.5 Workflow

The process for training and updating Bridge Inspectors is illustrated in Figure 2-6.

The corresponding workflow for the process is included in Figure 2-7.

Figure 2-6
Train/Update Bridge Inspectors

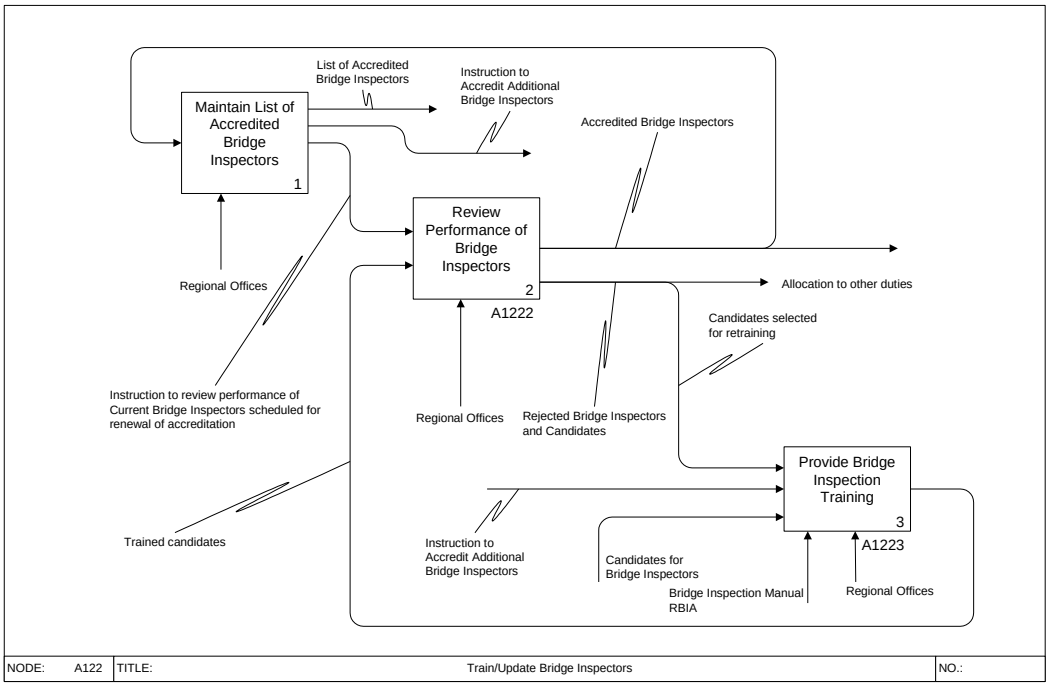
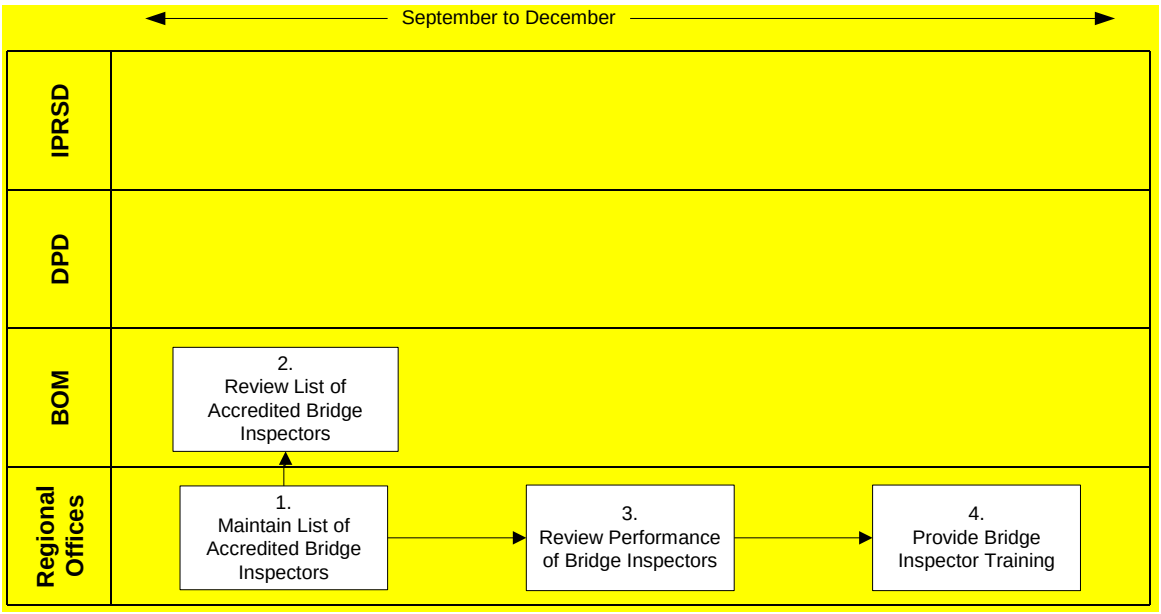


Figure 2-7
Workflow



Step 1	Maintain a list of accredited bridge inspectors in each region to ensure that sufficient accredited bridge inspectors are available in each region to undertake the annual bridge condition survey.
Step 2	Review the list of accredited bridge inspectors for each region to ensure that each region is maintaining an adequate pool of accredited bridge inspectors.
Step 3	Review the performance of the bridge inspectors to maintain the standard of existing bridge inspectors and to assess new candidates for bridge inspectors.
Step 4	Provide bridge inspector training to train candidate bridge inspectors and to retrain rejected bridge inspectors.

2.3.6 Activities

Maintain list of accredited bridge inspectors

The Bridge Data Coordinator in each regional office will maintain a list of the current accredited bridge inspectors available for duty in the region. The list shall record the name, current position, location, qualifications, age, date of initial accreditation as a bridge inspector and the date of the last renewal of accreditation.

Refer to Figure 2-8 for a typical list of Accredited Bridge Inspectors.

Each regional office shall forward a copy of the current list of accredited bridge inspectors to the BOM in September of each year.

The Bridge Data Coordinator will appoint a Regional Instructor to provide bridge inspector training and to review the performance of bridge inspectors. The Instructor will be a current Accredited Bridge Inspector.

Figure 2-8
List of Accredited Bridge Inspectors

Republic of the Philippines
Department of Public Works and Highways

BRIDGE MANAGEMENT SYSTEM

LIST OF ACCREDITED BRIDGE INSPECTORS

REGION: <insert region>

Name	Position	Location	Qualifications	Age (years)	Date Accredited	
					Original	Last

DATE OF ISSUE: <insert date of printing>

Form completed by:	Form checked by:	Form submitted by:

Insert Name, Position, Signature and Date of Signing

The Bridge Data Coordinator will arrange for the review of performance of those bridge inspectors whose accreditation has expired and candidate bridge inspectors, as necessary to maintain the required number of bridge inspectors.

The Bridge Data Coordinator will select candidates for training as bridge inspector, and arrange bridge inspection training, to maintain the required number of accredited bridge inspectors.

The candidates for bridge inspectors will be engineers or technicians, with experience in bridge design, construction or maintenance, drawn from the Planning and Design Division, Construction Division or Maintenance Division of the Regional Offices and Engineering District Offices.

It is considered that a trained bridge inspector is able to inspect approximately 90 bridges in a period of three (3) months. Therefore, the number of accredited bridge inspectors in each Region will be determined such that there are between 70 and 90 bridges to each bridge inspector.

The estimated number of bridge inspectors required in each region is summarized in Table 2-2. The number should be maintained within the limits shown, with a minimum of three (3) bridge inspectors in those regions with a small number of bridges. More than the required number of bridge inspectors should not be accredited to ensure that each bridge inspector does sufficient bridge inspections per year to maintain his/her bridge inspection skills.

Table 2-2
Bridge Distribution Analysis

Region	No. of Districts	No. of Bridges (a)	Bridges Per District	No. of Survey Teams		
				Min.	Opt.	Max
I	9	522	58.0	6	7	9
II	11	502	45.6	6	7	9
CAR	9	388	43.1	5	6	7
III	13	558	42.9	7	8	10
NCR	7	239	34.1	3	4	5
IV-A	16	623	38.9	7	8	10
IV-B	9	687	76.3	8	9	11
V	12	673	56.1	8	9	11
VI	14	845	60.4	10	12	14
VII	11	607	55.2	7	8	10
VIII	13	1,177	90.5	14	16	19
IX	8	259	32.4	3	4	5
X	9	378	42.0	5	5	7
XI	10	314	31.4	4	5	6
XII	6	303	50.5	4	5	6
XIII	8	475	59.4	6	6	8
ARMM	4	173	43.3	2	3	4
17	**169**	**8,723**	**51.6**	**105**	**122**	**151**

a. DPWH, Planning service, Bridge Inventory, DPWH Master Bridge Plan, May 2002

Review List of Accredited Bridge Inspectors

The Bureau of Maintenance shall review the List of Accredited Bridge Inspectors for each region and check that each region is maintaining a sufficient number of bridge inspectors to undertake the annual bridge condition survey.

Report BRO_03
Graph GRO_03

The Bureau of Maintenance will maintain records of the accredited bridge inspectors.

Review Performance of Bridge Inspectors

The workflow to review the performance of bridge inspectors is shown in Figure 2-9.

Bridge Inspection Trainees Manual
Bridge Inspection Instructors Manual
Bridge Inspection Manual

The Instructor will select say the number of bridges for testing. The bridges shall be of a range of types of construction (e.g. timber, steel and concrete bridges) and shall be in a fair to bad condition.

The Instructor will arrange a program for the candidate bridge inspectors to enable each candidate to inspect two (2) bridges on an individual basis.

The candidate bridge inspectors will undertake bridge inspections of the bridges allocated to them and prepare complete bridge inspection reports for review.

The Instructor will assess the test bridge condition reports submitted by the candidate bridge inspectors on the preset criteria. The Instructor will determine which of the candidates have achieved the required level.

Candidate bridge inspectors that have achieved the required level will be accredited as bridge inspectors for a period of five (5) years. Certification for bridge inspectors in shown in Figure 2-10.

Figure 2-9
Review Performance of Bridge Inspectors

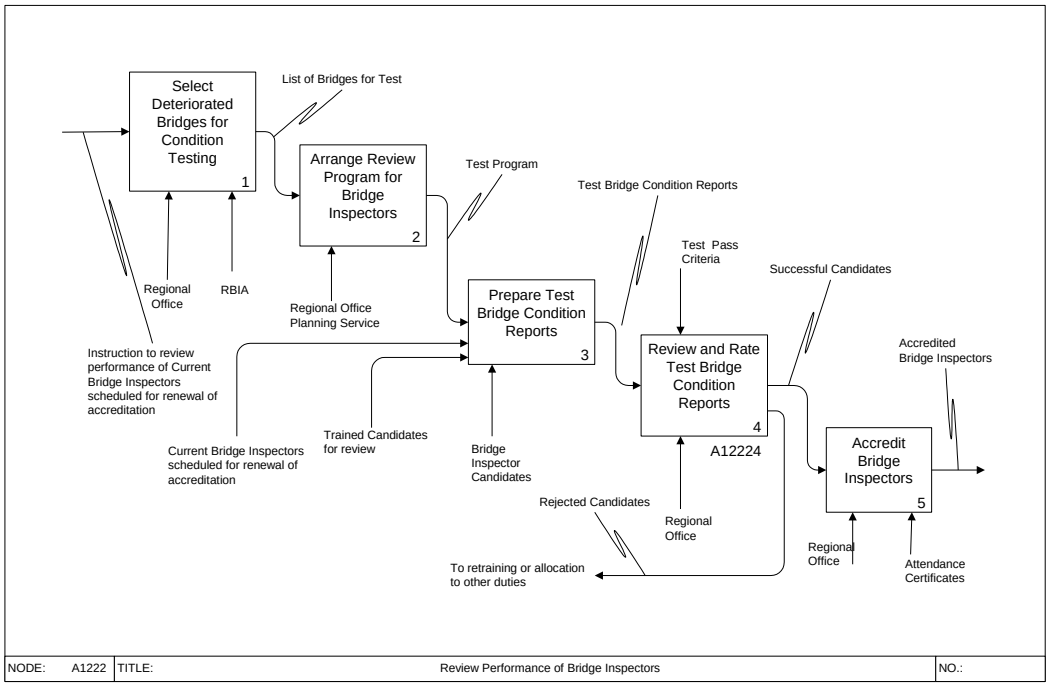


Figure 2-10
Accreditation Certificates

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
Pavement Management System/ Bridge Management System
DPWH - NCR Compound
Bonifacio Drive, Port Area, Manila

Certificate of Training

This is to certify that

[Insert Name]

has attended a course and satisfactorily completed a competency test in

BRIDGE CONDITION INSPECTION TRAINING

held at DPWH Regional Office, [Insert location]
on [Insert Dates]
Given this [Insert day] day of [Insert month, year]

[Insert name]
Bridge Training Coordinator

[Insert name]
Instructor

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
Pavement Management System/ Bridge Management System
DPWH - NCR Compound
Bonifacio Drive, Port Area, Manila

Certificate of Accreditation

This is to certify that

[Insert Name]

has attended a course and satisfactorily completed a competency test in bridge condition inspection training, and is hereby accredited as a

Bridge Inspector

for a period of five (5) years from the date of this Certificate.

Given this [Insert day] day of [Insert month, year]

[Insert name]
Bridge Training Coordinator

[Insert name]
Instructor

Provide Bridge Inspector Training

The workflow to review the provide bridge inspection training is shown in Figure 2-11.

Bridge Inspection Trainees Manual

Bridge Inspection Instructors Manual

Bridge Inspection Manual

The Instructor will review the qualifications and experience of candidates nominated for bridge inspection training and shall interview all candidates. Candidates may be rejected from the course if they do not have a bridge engineering background and if they are unlikely to be available to serve as a bridge inspector for the next five (5) years.

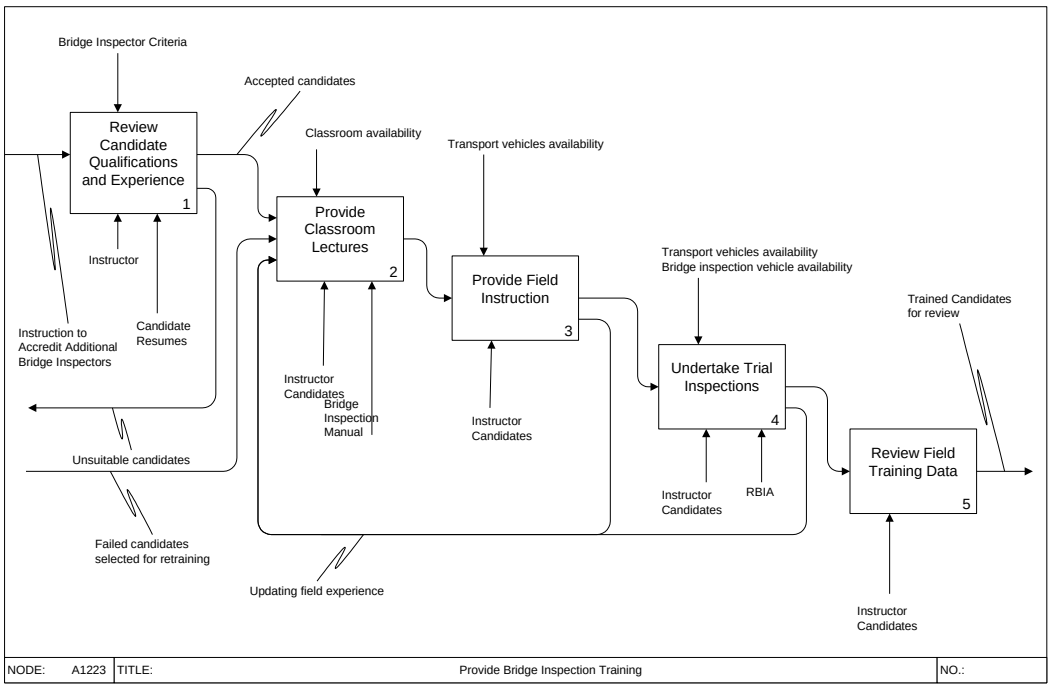
Classroom lectures will be provided to introduce the candidates to bridge inspection procedures, to describe bridge defects and to describe bridge inspection techniques.

Trial inspections will be made of two (2) bridges to illustrate the preparation of bridge inventory and condition reports. The outcomes of these inspections shall be discussed in the classroom.

Trial inspections — The paired candidates will undertake trial inspections of allocated bridges and prepare bridge inspection reports.

Review training data — The results of these bridge inspection reports will be discussed in detail in the classroom.

Figure 2-11
Bridge Inspection Training



2.4 Procedure A123 - Prepare Bridge Condition Reports

2.4.1 Objectives.

To provide annual bridge inspection reports and bridge condition data, and to update the RBIA with current bridge condition data for all bridges in each region.

2.4.2 Definitions

Annual bridge condition inspection	Annual inspection of defined attributes of bridge to assess condition of bridge and estimate maintenance requirements.

2.4.3 Application User Coordinator

Bureau of Maintenance (BOM)

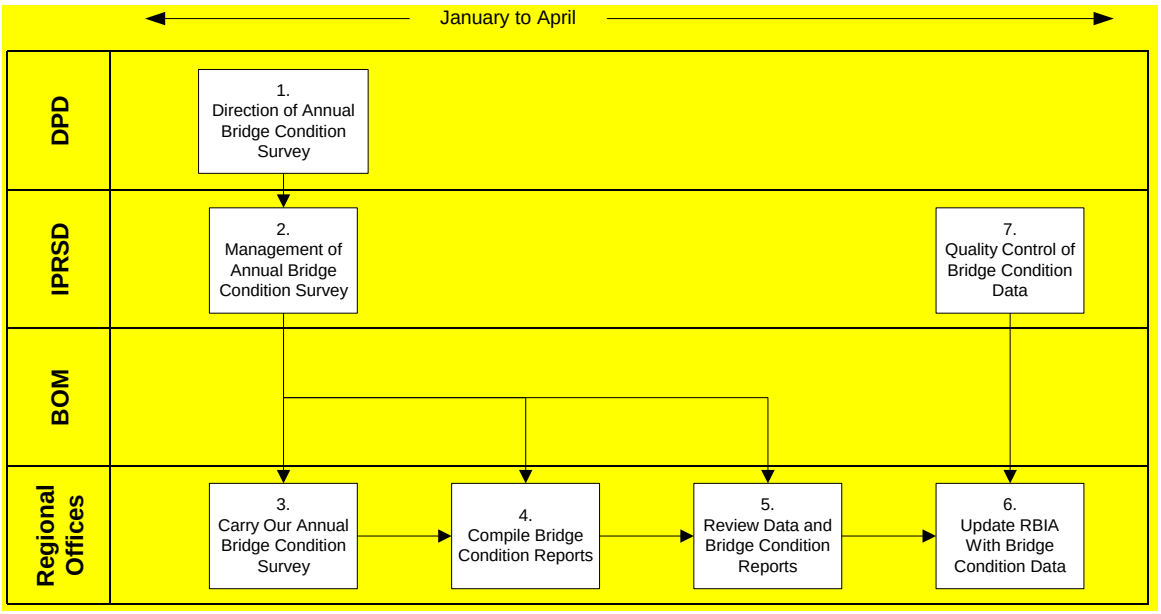
2.4.4 Users

Regional Office Maintenance Divisions (ROMDs)
Engineering Districts Offices (EDOs)

2.4.5 Workflow

The workflow for the activity is included in Figure 2-12.

Figure 2-12
Workflow



Step 1 Direction of the annual condition survey to ensure that it is undertaken to the required standard and timing.

Step 2	Management of the annual bridge condition survey to ensure the bridge condition data is collected and processed to the required program.
Step 3	Carry out annual bridge condition inspections of all bridges in each region to complete the Condition Inspection Form.
Step 4	Compile bridge inspection reports including all additional items, and reviewing and checking the condition inspection data for accuracy.
Step 5	To review the completion and checking of the Condition Inspection Reports, to identify any areas of non-conformance and to develop corrective action to address the issues.
Step 6	Update BMS Database within the RBIA with bridge condition data from Bridge Inspection Reports including the verification of the updated data.
Step 7	Quality assurance of the bridge condition data to ensure that it meets the requirements of the BMS.

2.4.6 Activities

Carry out annual bridge inspections	The nominated Accredited Bridge Inspector will inspect each bridge in detail; to obtain the condition and other data required to complete the Condition Inspection Form.
Bridge Inspection Manual	The bridge inspection will be carried out in accordance with the Bridge Inspection Manual.
Form BC_01	The data to be determined during the inspection includes: • Confirmation of location data, • Site visit record photograph (Refer Figure 2-13), • Review and correction of Bridge Inventory Report, • Review of any existing Engineering Inspection Summary Sheet, • Preparation of routine maintenance estimates, • Assessment of condition state, appropriate repair method if required and estimated repair cost for all defined bridge attributes, • Condition photographs, • Assessment of overall bridge condition and remaining life, and

- Recommendation on necessary intervention to bridge.

The Bridge Condition Form will be completed on site.

The inspection will be undertaken with sufficient bridge inspection equipment to enable all attributes to be fully inspected. If necessary, a bridge inspection vehicle will be used to fully inspect the bridge.

Figure 2-13
Typical Site Visit Record Photograph

Compile Bridge Condition Reports

Bridge Inspection Manual

The Bridge Inspector allocated to each bridge will be responsible for compiling a complete Bridge Inspection Report for each bridge.

These reports will be prepared in accordance with the Bridge Inspection Manual.

The Bridge Condition Reports will comprise:

- Completed Bridge Condition Form,
- Supporting information for proposed major maintenance to attributes,
- Cost estimates for routine maintenance,
- Cost estimates for proposed major maintenance to defective attributes,
- Site visit record photograph, and
- Photographs of defects in attributes.

Photographs will be included in both hard copy and electronic form. Electronic photographs will be given file names in the following formats:

Site visit record photographs:
B00057LZ_JUN03_VISIT_1.*

Inventory photographs:
B00034LZ_AUG04_INVENT_1.*

Photographs of defects:
B00017LZ_MAY03_PIER1_FOUNDATION_1.*

Electronic photographs shall be downloaded from digital cameras or scanners into the BMS_PHOTOS file storage area in the RBIA.

Review Data and Bridge Inspection Reports

The completed Condition Inspection Reports comprising Bridge Condition Inspection Forms and specified attachments will be checked by the Data Coordinator to ensure that all data has been collected.

The following checks will be undertaken:

- The condition inspection form has been completed by a current Accredited Bridge Inspector,
- All bridge attributes have been fully inspected (no partial or non assessments),
- The routine maintenance estimates are relevant to the type of bridge,
- The condition state has been estimated or marked as not applicable for all defined attributes,
- The type of maintenance has been estimated for all attributes with condition state of 1, 2 or 3,
- The estimated cost of maintenance has been estimated for all attributes with condition state of 2 or 3.

- Supporting material has been attached for all maintenance estimates,
- The completion of the major maintenance section has been based on Engineering Inspection Summary Sheet data, where available,
- The pier scour/erosion checks have been completed,
- The overall bridge condition, recommended intervention and remaining life have been given,
- A bridge site visit photograph has been included, and
- Photographs of all recorded defects are included.

Any incomplete Condition Inspection Reports will be returned to the allocated Bridge Inspector for additional work and amendment of the Report.

The Data Coordinator shall maintain records of issues arising from the completion and checking of Condition Inspection Forms and divide these into non-specific and systemic errors.

The Data Coordinator shall determine the cause of all such systemic errors and shall develop corrective actions to be taken to overcome the issues.

Possible corrective actions could include:

- Additional instructions to Bridge Engineers,
- Provision of additional equipment,
- Provision of bridge inspection vehicle,
- Modified Condition Inspection forms, and
- Modified bridge inspection procedures.

The Regional Offices shall forward details of all corrective actions undertaken within the regions to the Bureau of Maintenance. The Bureau of Maintenance shall review these corrective actions and undertake any necessary modifications to the bridge inspection system.

Various data validation process carried out with RBIA can identify the data issues based on the inconsistency between different data items. To ensure that the condition data collected truly represents the bridge condition and carried out according to the principles of Bridge Inspection Manual, random field validation are recommended for at least 1 % of the bridges.

It is recommended that, initially, at least 10 % of the data collected should go through this validation process. If the inconsistencies are found in more than 5 % of the validated bridges, then all the condition data collected during that survey should be validated.

The photographs recorded of the bridge during the bridge inspection survey should be compared to the data recorded in the bridge condition reports to identify any issues with the data.

Update BMS Database

Guide to BMS Training Exercises Module 12

Each regional office shall update the BMS data within the RBIA by loading the bridge condition data. This may be done either manually for each bridge or using bulk loading of data compiled into a spreadsheet.

Minimum and maximum limits are defined for each data item. The RBIA will accept only those data that fall within these limits. Similarly in the case of data item with the selection list, it will accept only data matching with the text in the list.

A check shall be made that all bridges in the region have been included in the annual bridge condition survey by printing out an Annual Bridge Condition Survey Report for the region.

Guide to BMS Training Exercises Module 16

The annual condition data in the RBIA for the current survey shall be reviewed for correctness and consistency by printing out the condition bridge data reports as follows:

- BRDC_01 Overall Condition Assessment
- BRDC_02 Abutment Condition Part 1
- BRDC_03 Abutment Condition Part 2
- BRDC_04 Pier Condition
- BRDC_05 Span Condition
- BRDC_06 Routine Maintenance BMS Estimates

These reports shall be reviewed to confirm that all data has been entered correctly, that all required data has been entered and that all entered data is consistent.

The electronic copies of the bridge record photographs shall also be loaded into the RBIA and linked to the BMS screens.

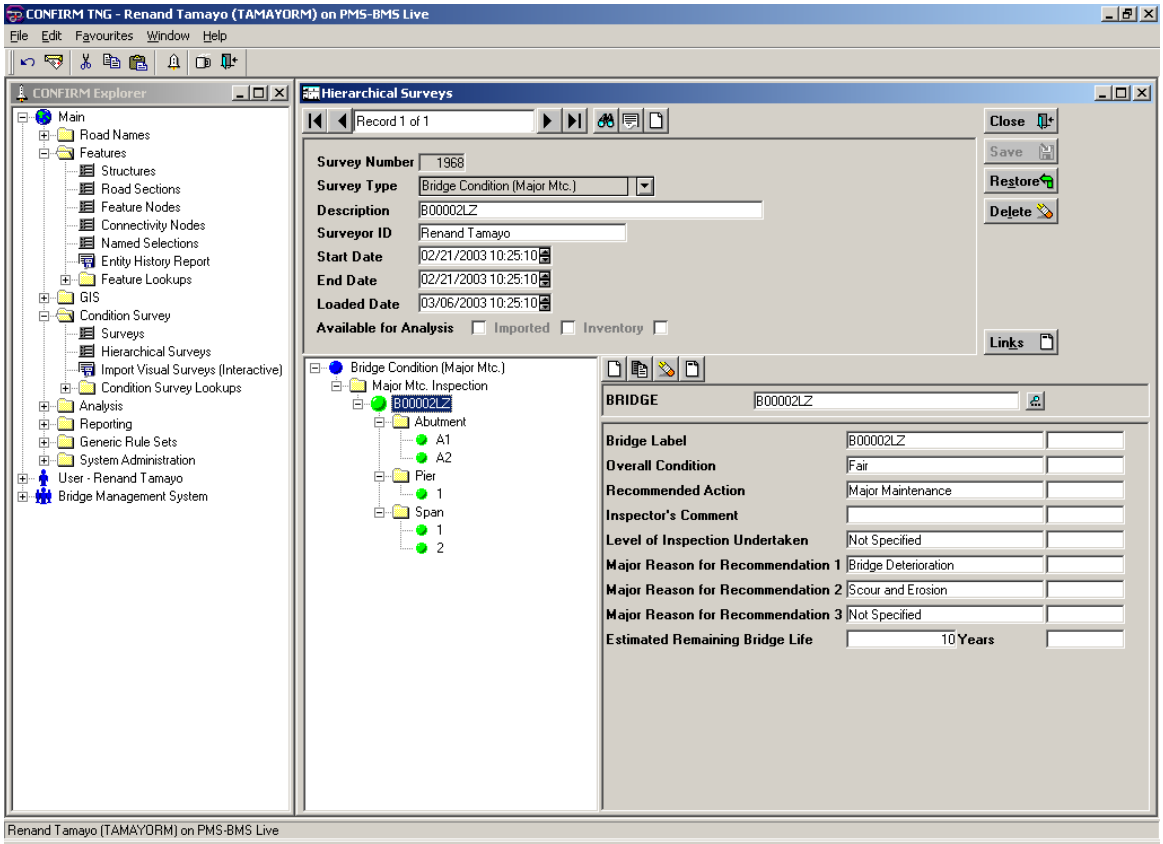
2.4.7 Actions in the RBIA

Log in to the RBIA with appropriate user privileges (Level 4: Data Entry).

Guide to BMS Training Exercises Module 13

Enter the bridge overall condition data using the Hierarchical Survey screen shown in Figure 2-14.

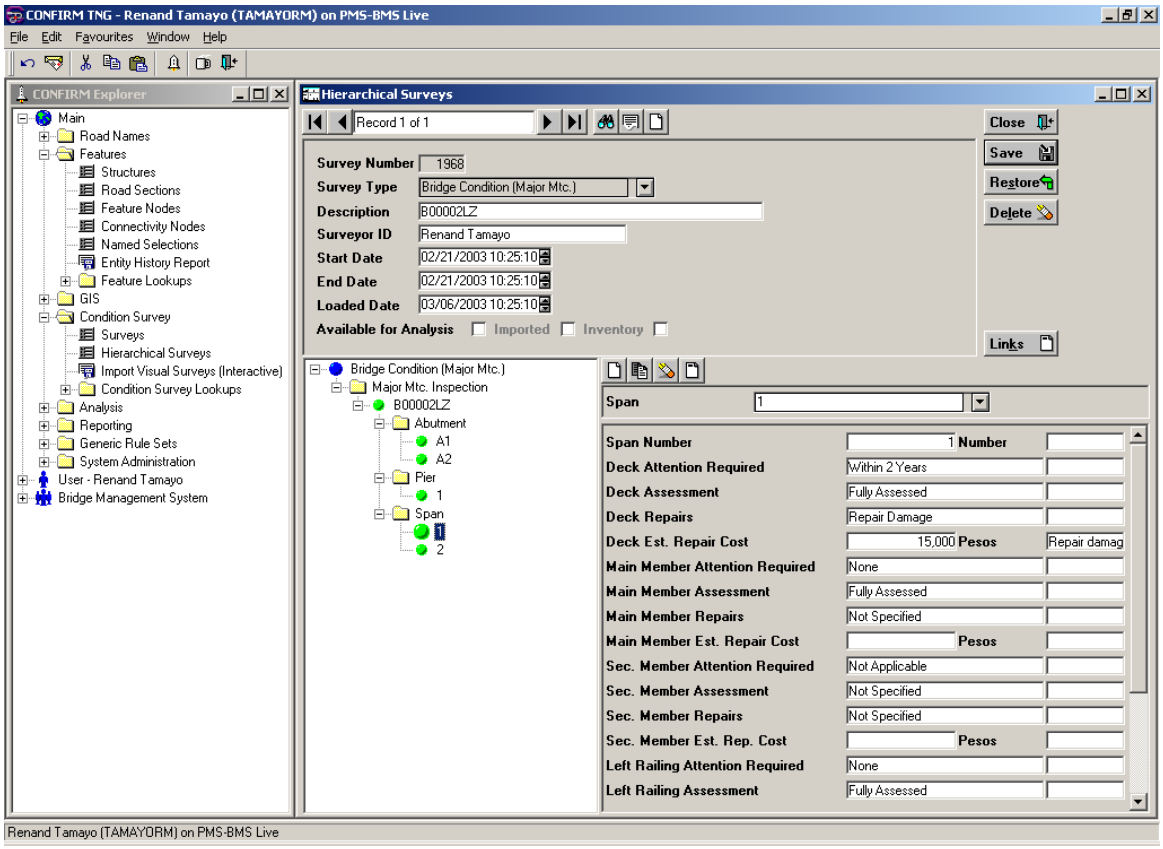
Figure 2-14
Condition Inspection Data Entry Screen



Guide to BMS Training Exercises Module 13

Enter the attribute major maintenance data using the Bridge Surveys (Major Maintenance) screen shown in Figure 2-15.

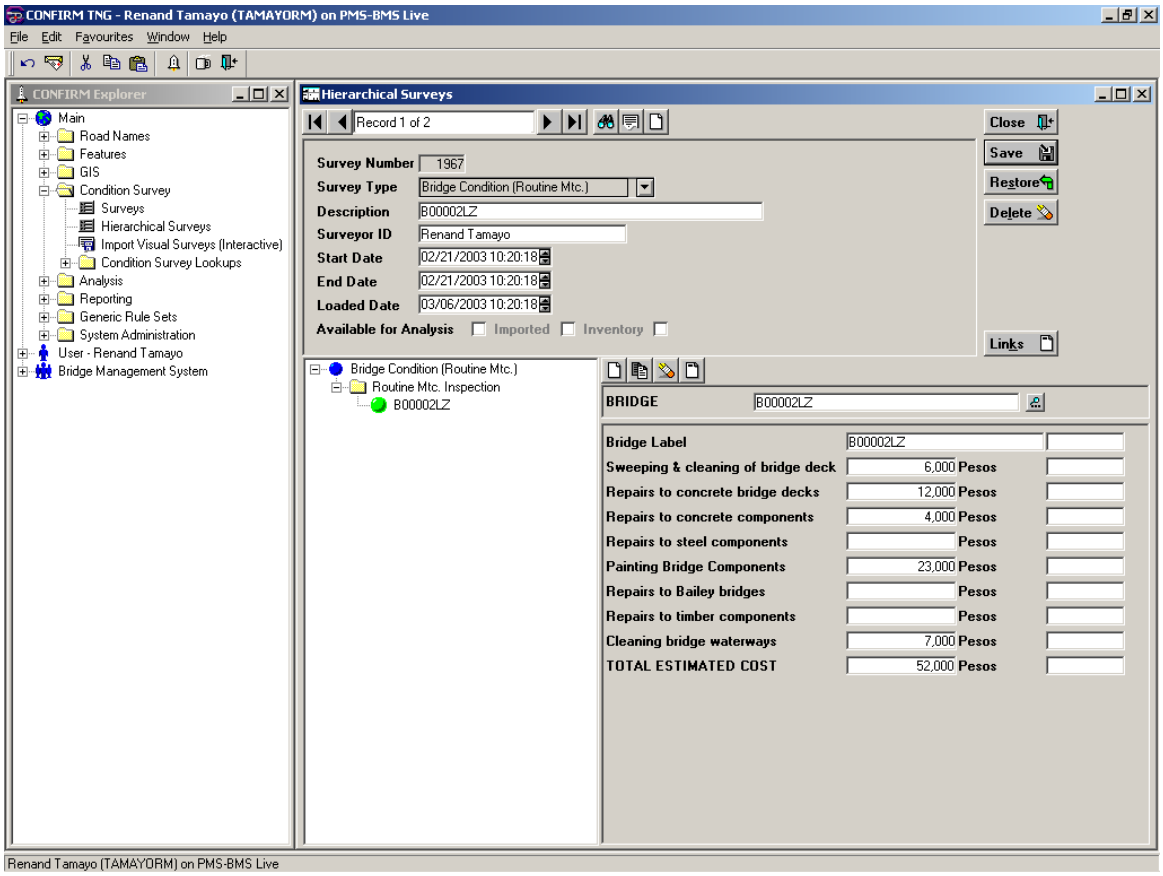
Figure 2-15
Major Maintenance Data Entry Screen



Guide to BMS Training Exercises Module 13

Enter the bridge routine maintenance data using the Bridge Surveys (Routine Maintenance) screen shown in Figure 2-16.

Figure 2-16
Routine Maintenance Data Entry Screen



3 BRIDGE DATA ANALYSIS PROCEDURES

3.1 Overview

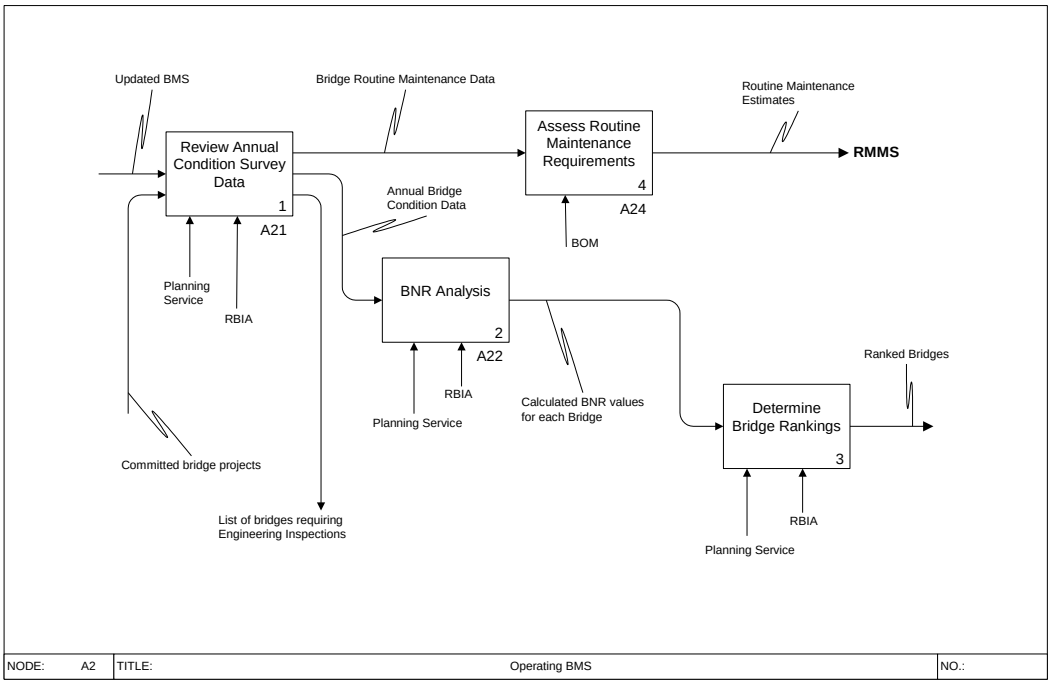
Bridge inventory and condition data collected by DPWH should be used to carry out various analyses related to the planning and programming processes of the road network and bridge assets. Identifying the maintenance needs, prioritizing the potential maintenance works for bridge preservation based on the maintenance need and importance of the bridge in the road network are some of the analyses required for programming the bridge preservation.

Separate procedures are available for the following consecutive stages of the data analysis process for the bridge maintenance planning:

- A21 - Review Condition Data
- A22 – Assess Bridge Requirements and Ranking
- A24 – Assess Routine Maintenance Requirements

The overall procedures for the BMS data analysis are shown in Figure 3-1.

Figure 3-1
BMS Data Analysis Procedures



3.2 Procedure A21 - Review Condition Data

3.2.1 Objectives.

All bridge condition data loaded into the BMS must be reviewed for accuracy and consistency. This procedure will help to ensure the reliability of the bridge condition data.

This process should be carried out before running any BMS analysis. Any anomalies identified should be rectified before proceeding further with analysis.

3.2.2 Definitions

Condition Data — Bridge condition data received from an annual bridge condition inspection survey.

3.2.3 Application User Coordinators

Planning Service (PS)

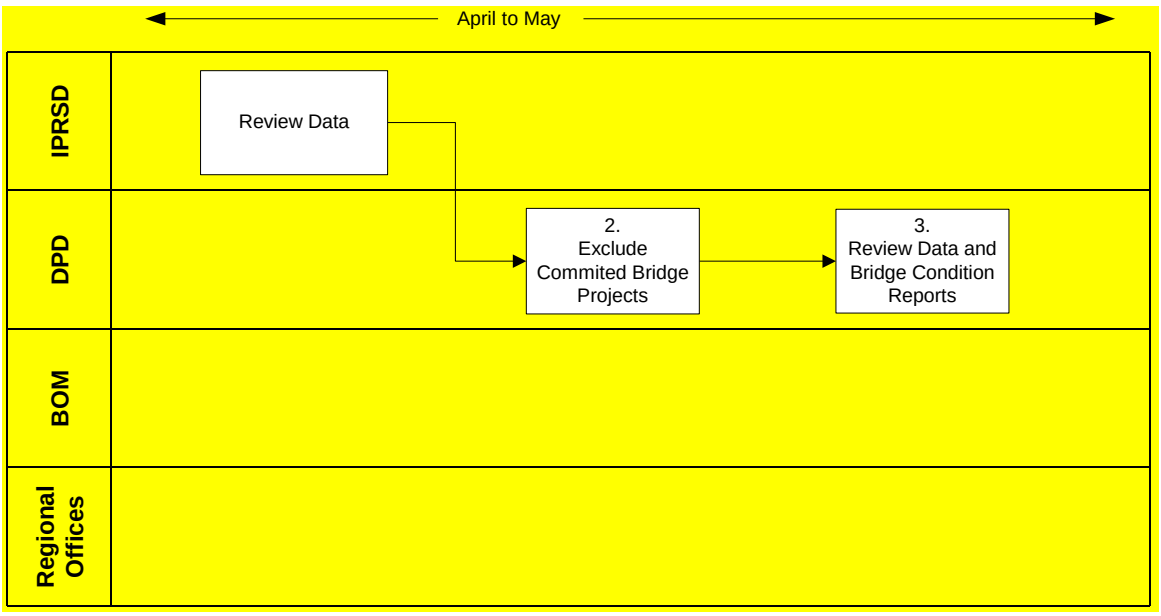
3.2.4 Users

Planning Service (PS)

3.2.5 Workflow

The workflow for the procedure is included in Figure 3-2.

Figure 3-2
Workflow for Review Condition Data



Step 1 — Review condition data loaded into the RBIA by the regional offices, confirm that the data meets the quality requirements, take corrective action as necessary and produce bridge condition data reports.

Step 2 — Ensure that committed projects are excluded from the BMS analysis.

Step 3 — Determine which bridges require engineering inspection reports and issue Brief to the regional offices for these inspections.

3.2.6 Activities

Review condition data loaded into the RBIA by the regional offices

The data loaded into the RBIA in the regional offices would be critically reviewed for coverage, completeness and accuracy. This review would be undertaken by the following methods:

Report BRO_01

Report BRO_02

Reports BRDC_01 to BRDC_06

- Preparation of an Annual Bridge Condition Survey Report,
- Preparation of an Bridge Engineering Inspections Report (Refer Figure 3-3),
- A general review of all data by the use of the standard Reports on Bridge Data in RBIA (Refer Table 3-1 and Figure 3-4), and
- A detailed check of the data for 5% of the bridges based on a review of the recorded bridge photographs to check that the condition state recorded were consistent with the bridge inventory.

Table 3-1
Report Formats for Condition Data Review

Report ID	Report Name
BRDC_01	Overall Bridge Condition Assessment
BRDC_02	Abutment Condition Part 1
BRDC_03	Abutment Condition Part 2
BRDC_04	Pier Condition
BRDC_05	Span Condition
BRDC_06	Routine Maintenance BMS Estimates

Confirm that the data meets the quality requirements

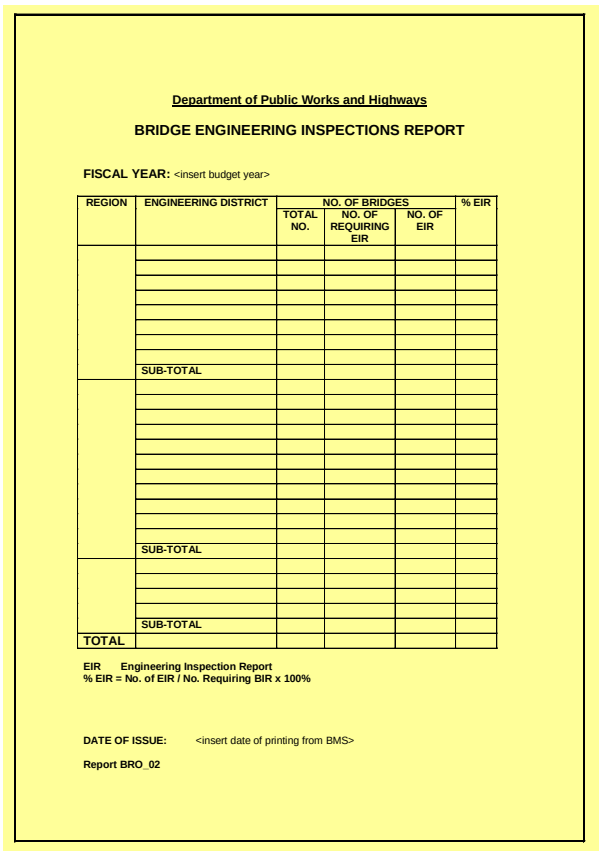
A comparison would be made of the recorded *Overall Bridge Condition*, *Recommended Action to Bridge*, and *Estimated Remaining Bridge Life* to determine if the data were consistent.

For example, the data would be suspect if a bridge was recorded to be in a ***good*** state and the recommended action was ***replacement***.

Take corrective action as necessary

All data discrepancies noted would be recorded and notes would be prepared for issue during the next annual bridge condition survey, to address the cause of the discrepancies. This may be in the form of additional notes on interpretation of various type of activity, intervention methods, etc.

Figure 3-3
Bridge Engineering Inspection Report



Department of Public Works and Highways

BRIDGE ENGINEERING INSPECTIONS REPORT

FISCAL YEAR: <insert budget year>

REGION	ENGINEERING DISTRICT	NO. OF BRIDGES			% EIR
		TOTAL NO.	NO. OF REQUIRING EIR	NO. OF EIR	
	SUB-TOTAL				
	SUB-TOTAL				
	SUB-TOTAL				
TOTAL					

EIR Engineering Inspection Report
% EIR = No. of EIR / No. Requiring BIR x 100%

DATE OF ISSUE: <insert date of printing from BMS>

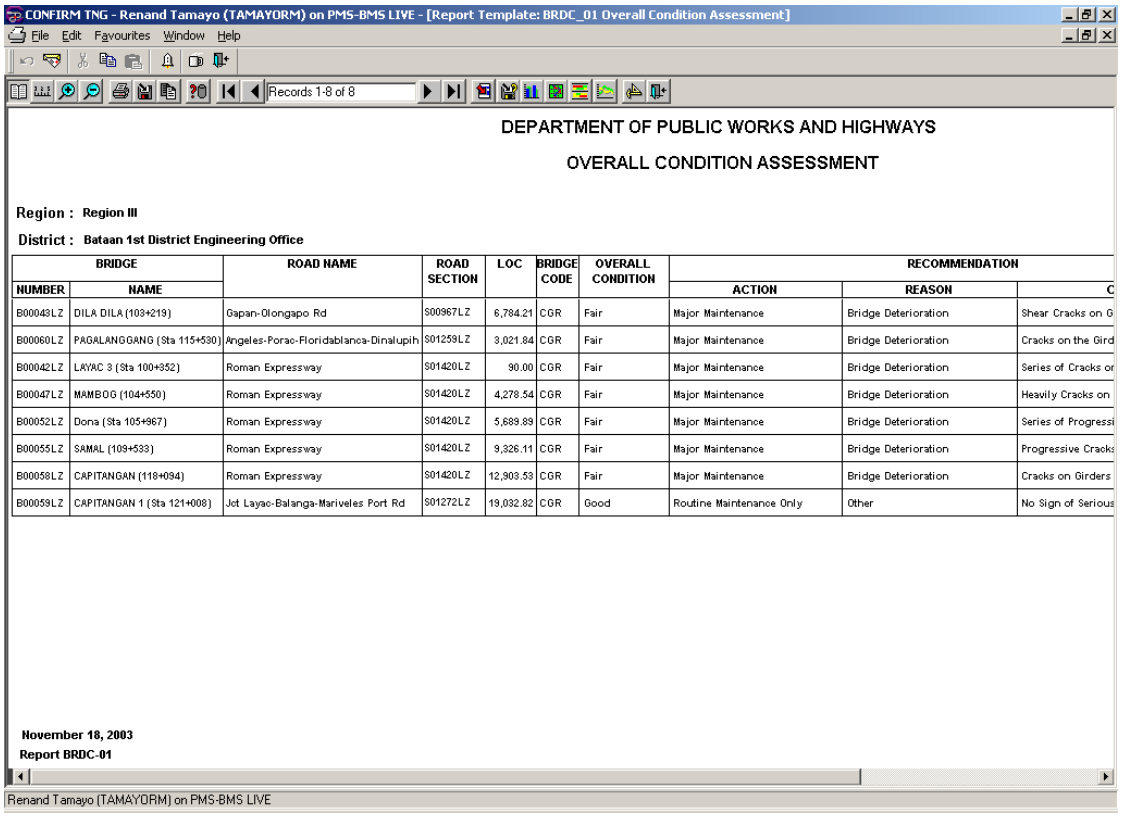
Report BRO_02

Following the data review, the data resulting from the annual bridge condition survey would be accepted for use in the BMS.

Some regions may not have completed bridge condition reports and the loading of the data into the RBIA for all bridges in the region by April. These bridges will be omitted from the BMS analysis as the analysis uses only current data, i.e. data from the current annual bridge condition survey.

This action should encourage the regional offices to give priority to the annual bridge condition survey, if those regions are to be included in the Major Maintenance Program and Network Development Program.

Figure 3-4
Typical BMS Report on Bridge Data in RBIA


CONFIRM TNG - Renand Tamayo (TAMAYORM) on PMS-BMS LIVE - [Report Template: BRDC_01 Overall Condition Assessment]

File Edit Favourites Window Help

Records 1-8 of 8

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

OVERALL CONDITION ASSESSMENT

Region : Region III

District : Bataan 1st District Engineering Office

BRIDGE		ROAD NAME	ROAD SECTION	LOC	BRIDGE CODE	OVERALL CONDITION	RECOMMENDATION		
NUMBER	NAME						ACTION	REASON	C
B00043LZ	DILA DILA (103+219)	Gapan-Olongapo Rd	S00967LZ	6,784.21	CGR	Fair	Major Maintenance	Bridge Deterioration	Shear Cracks on G
B00060LZ	PAGALANGGANG (Sta 115+530)	Angeles-Porac-Floridablanca-Dinalupih	S01259LZ	3,021.84	CGR	Fair	Major Maintenance	Bridge Deterioration	Cracks on the Gird
B00042LZ	LAYAC 3 (Sta 100+352)	Roman Expressway	S01420LZ	90.00	CGR	Fair	Major Maintenance	Bridge Deterioration	Series of Cracks or
B00047LZ	MAMBOG (104+550)	Roman Expressway	S01420LZ	4,278.54	CGR	Fair	Major Maintenance	Bridge Deterioration	Heavily Cracks on
B00052LZ	Dona (Sta 105+967)	Roman Expressway	S01420LZ	5,689.89	CGR	Fair	Major Maintenance	Bridge Deterioration	Series of Progressi
B00055LZ	SAMAL (109+533)	Roman Expressway	S01420LZ	9,326.11	CGR	Fair	Major Maintenance	Bridge Deterioration	Progressive Cracks
B00058LZ	CAPITANGAN (118+094)	Roman Expressway	S01420LZ	12,903.53	CGR	Fair	Major Maintenance	Bridge Deterioration	Cracks on Girders
B00059LZ	CAPITANGAN 1 (Sta 121+008)	Jct Layac-Balanga-Mariveles Port Rd	S01272LZ	19,032.82	CGR	Good	Routine Maintenance Only	Other	No Sign of Serious

November 18, 2003
Report BRDC-01

Renand Tamayo (TAMAYORM) on PMS-BMS LIVE

Produce bridge condition data reports

Following the acceptance of the annual bridge condition survey data in the RBIA, the full range of bridge inventory and condition reports may be produced as required to support other activities.

BMS Operation and User Manual, Volume 1 – Operation Guide

The available report formats are detailed in Appendix B of Volume 1.

Typical reports are:

- Report BRMI_01 Total Number of Bridges, Country Summary, refer Figure 3-5,
- Graph BGMC_02 Total Number of Bridges in Different Conditions by Percentage, refer Figure 3-6, and
- Report BRMI_04 Distribution of Bridges by Bridge Code, refer Figure 3-7.

Exclude committed bridge projects

The annual bridge condition survey will include all national bridges. Some of these bridges will have been accepted into funded bridge programs in previous budgets and are therefore committed.

It is necessary to exclude these bridges from the BMS analyses to prevent bridges being listed more than once.

This will be achieved by transferring data on committed projects held in the CMS Application to the RBIA on a batch basis, in June of each year.

Figure 3-5
Typical Bridge Report

Department of Public Works and Highways

TOTAL NUMBER OF BRIDGES
COUNTRY SUMMARY

FISCAL YEAR: <insert budget year>

REGION	NO. OF BRIDGES WITH MAIN MATERIAL OF CONSTRUCTION OF:						TOTAL NO. OF BRIDGES
	TIMBER	STEEL	CONCRETE	MASONRY	OTHERS	NOT SPECIFIED	
I							
II							
CAR							
III							
NCR							
IV-A							
IV-B							
V							
VI							
VII							
VIII							
IX							
X							
XI							
XII							
XIII							
ARMM							
TOTAL							

DATE OF ISSUE: <insert date of printing from BMS>

Report BRMI_01

Figure 3-6
Typical Bridge Condition summary Report

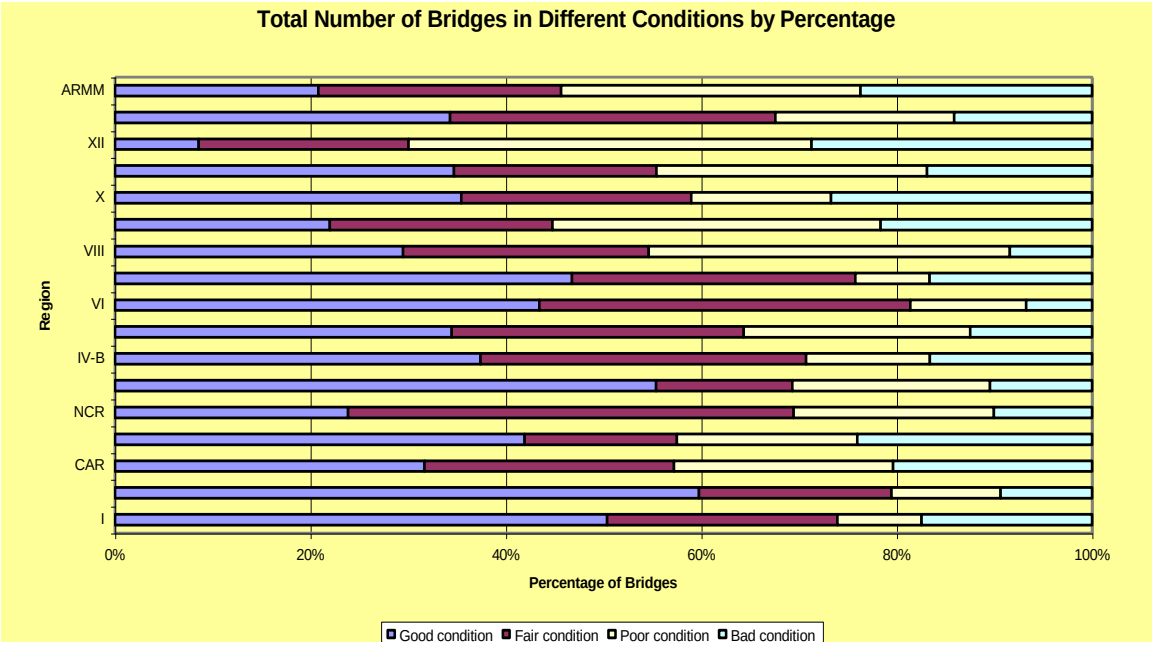
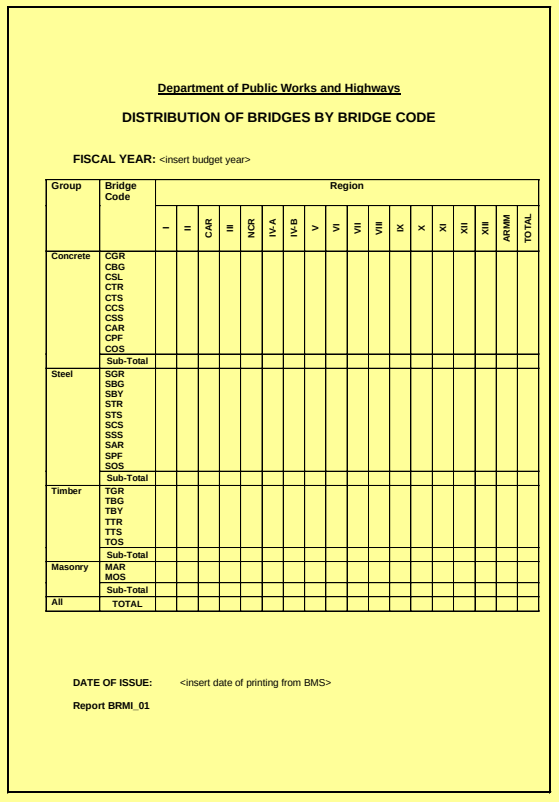


Figure 3-7
Typical Bridge Type Report



Department of Public Works and Highways

DISTRIBUTION OF BRIDGES BY BRIDGE CODE

FISCAL YEAR: <insert budget year>

Group	Bridge Code	Region																
		I	II	CAR	III	NCR	IV-A	IV-B	V	VI	VII	VIII	IX	X	XI	XII	XIII	ARMM	TOTAL
Concrete	CGR																		
	CBG																		
	CSL																		
	CTR																		
	CTS																		
	CCS																		
	CSS																		
	CAR																		
	CPF																		
	COS																		
	Sub-Total																		
Steel	SGR																		
	SBG																		
	SBY																		
	STR																		
	STS																		
	SCS																		
	SSS																		
	SAR																		
	SPF																		
	SOS																		
	Sub-Total																		
Timber	TGR																		
	TBG																		
	TBY																		
	TTR																		
	TTS																		
	TOS																		
	Sub-Total																		
Masonry	MAR																		
	MOS																		
	Sub-Total																		
All	TOTAL																		

DATE OF ISSUE: <insert date of printing from BMS>

Report BRMI_01

3.3 Procedure A22 – BNR Analysis and Ranking

3.3.1 Objectives.

This procedure will provide a method for ranking of the intervention needs requirement of each bridge based on the calculated normalized Bridge Needs Ratio (BNR) parameter.

3.3.2 Definitions

BMC	Bridge Maintenance Cost
BNR	Bridge Need Ratio
BPS	Bridge Priority Score
BRF	Bridge Route Factor
ECRP	Estimated Cost for Replacement Bridge
NMPS	Normalized Maintenance Priority Score

3.3.3 Application User Coordinators

Planning Service (PS) – DPD

3.3.4 Users

Planning Service (PS) -

3.3.5 Workflow

Step 1 Ensure that the data in the RBIA from the current bridge condition survey is complete and accurate for all regions.

Step 2 Set end dates for bridge condition data to be considered in BNR analysis. Bridges in late regions will be omitted by this action.

Step 3 Review BNR algorithms and set parameters and confirm algorithms and set parameters to be used in the BNR analysis.

Step 4 Undertake BNR analysis.

Step 5 Review BNR output for data errors.

Step 6 Rank the bridges based on BNR.

3.3.6 BNR Algorithms

The BMS allows flexibility for the formula used to compute the BNR used for ranking of bridges requiring intervention.

The BNR can be determined based on any or all of the following parameters:

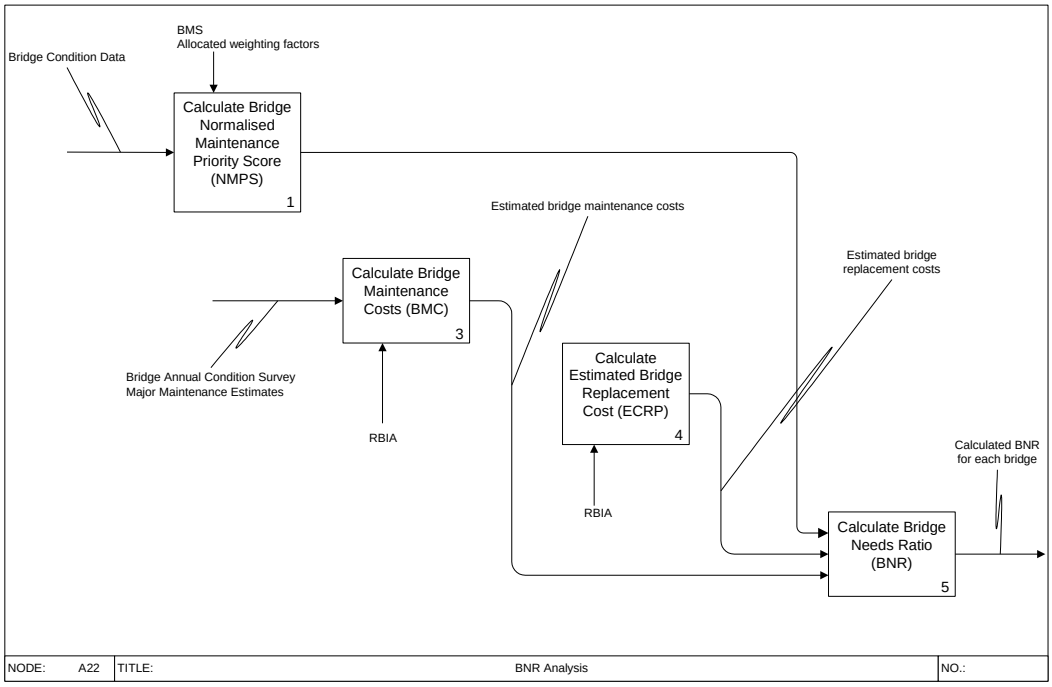
- NMPS
- BRF
- BMC
- ECRP

The NMPS is based on the bridge condition data and must be included in any determination. The other factors can be included to enable different intervention strategies to be tested.

The calculation of bridge BNR factors and ranking process is shown in Figure 3-8. The process includes the following calculation steps for use if desired:

- Calculation of the NMPS
- Estimation of the BRF
- Calculation of the BMC
- Calculation of the ECRP
- Calculation of the BNR

Figure 3-8
Calculation of Bridge BNR Factors



Calculation of NMPS

Normalized Maintenance Priority Score (NMPS) is calculated using the following expressions:

$$NMPS = \frac{\sum C_i W_i}{\sum C_{\max} W_i}$$

Where:

I is the attribute number
C_i is the condition state of attribute I
C_{max} is the maximum condition state for any attribute (3)
W_i is the weighting for attribute I

The purpose of normalizing is to bring the scores for all bridges on to the same scale of 0 to 1.

Bridge attributes are allocated a weighting factor (W_i) by expert consensus to reflect their relative importance to the stability and safety of the bridge. These factors are the same for all bridges. Table 3-2 gives the weighting factors used for various bridge attributes.

Table 3-2
Bridge Attribute Weighting Factors

Element	Attribute	Weighting Factor	Links
Span	Deck	3.0	
	Main members	8.0	
	Secondary members	6.0	
	Left parapet	1.0	
	Right parapet	1.0	
Pier	Main structure	4.0	1
	Foundation	4.0	2
	Expansion joint	2.0	3
	Bearings/restraints	3.0	4
	Scour protection	2.0	
Abutment	Main structure	4.0	1
	Foundation	4.0	2
	Bearings/restraints	3.0	4
	Expansion joint	2.0	3
	Left wing wall	0.5	
	Right wing wall	0.5	
	Scour/bank protection	2.0	
	Bridge approach	1.0	

Weighting factors need to be modified within the BMS. Weighting factors with numbered links need to be identical (e.g., weightings factors for foundations for piers and abutments have to be identical (e.g. 4.0))

Estimation of BRF

The Bridge Route Factors (BRF) are estimated based on the DPWH road integrity classification included in the RBIA to enable priority in the BMS analysis to be given to roads of a particular class, e.g. the north-south backbone roads.

Typical bridge route factors are given in Table 3-3.

Table 3-3
Typical Bridge Route Factors (BRF)

Road Integrity	Bridge Route Factor
North - South backbone roads	1.00
East - West lateral roads	0.75
National secondary roads	0.50
Other roads of strategic importance	0.25

The range for BRF factors is from 0 to 1 to ensure that the resulting analyses are normalized.

Calculation of BMC

The Bridge Maintenance Cost (BMC) is determined for each bridge based on the total cost of repair for all attributes included in the bridge condition inspection form.

BMC = Sum of Attribute Maintenance Costs

Maintenance costs of attributes are only estimated for components in condition states 2 or 3.

Calculation of ECRP

The ECRP is the estimated replacement cost of the bridge by a bridge of standard DPWH design. It is sufficiently accurate to calculate this value based on the plan surface area of the existing bridge deck.

ECRP = (LB) (WD) (AC)

Where:

LB is the overall length of bridge (m)
WD is the overall width of bridge (m)
AC is the notional bridge replacement cost in Pesos per square meter of deck.

The value of AC to be used each year has to be reviewed and revised on an annual basis by the Planning Service, based on the average construction cost in Pesos per square meter of bridge deck area for all bridge construction contracts completed by the DPWH in the preceding year.

Calculation of BNR

The Bridge Need Ratio (BNR) may be calculated using a formula based on NMPS, BFR, BMC and ECRP.

Tentative formulas include:

No. 1 BNR = NMPS

No. 2 BNR = NMPS x BRF

No. 3 BNR = NMPS x BRF x (ECRP – RMC) / ECRP

No. 4 BNR = NMPS x BRF x ECRP / BMC

It is recommended that the initial use of the BMS should be based on formula No. 1, therefore:

BNR = NMPS

This formula is stable and will give reliable results based on equal treatment of all bridges and interventions.

The formula will require extensive review based on field data to confirm the basic structure and to modify the formula and parameters to suit local conditions and requirements.

3.3.7 Worked Example

Table 3-4 shows typical bridge condition summary data for a typical bridge and shows how the NMPS is calculated based on the recorded condition state the defined attributed.

The calculation omits those bridge attributes that are recorded during the condition inspection as not applicable, as these attributed do not exist in the bridge. For example, a concrete girder and deck slab bridge does not have secondary members and these attributes would be recorded as not applicable.

Table 3-4
Example Bridge Priority Calculation

Bridge Element	Bridge Attribute	Major Maintenance Cost	Ci	Wi	Wi Ci	Wi $Ci_{max.}$
Span 1	Deck Condition	20,000.00	2	3	6	9
	Main Member	500,000.00	3	8	24	24
	Secondary Member	0.00	NA	6	0	0
	Left Parapet	0.00	1	1	1	3
	Right Parapet	0.00	1	1	1	3
Span 2	Deck Condition	20,000.00	2	3	6	9
	Main Member	400,000.00	3	8	24	24
	Secondary Member	0.00	NA	6	0	0
	Left Parapet	0.00	1	1	1	3
	Right Parapet	0.00	1	1	1	3
Pier 1	Main structure	0.00	1	4	4	12
	Foundation	0.00	0	4	0	12
	Expansion joint	0.00	NA	2	0	0
	Bearings/restraints	0.00	0	3	0	9
	Scour protection	0.00	1	2	2	6
Abutment 1	Main structure	0.00	0	4	0	12
	Foundation	0.00	1	4	4	12
	Bearings/restraints	0.00	0	3	0	9
	Expansion joint	0.00	0	2	0	6
	Left wing wall	0.00	0	0.5	0	1.5
	Right wingwall	0.00	0	0.5	0	1.5
	Scour/bank protection	0.00	1	2	2	6
	Bridge approach	0.00	0	1	0	3
Abutment 2	Main structure	0.00	1	4	1	12
	Foundation	40,000.00	3	4	3	12
	Bearings/restraints	0.00	1	3	1	9
	Expansion joint	0.00	0	2	0	6
	Left wing wall	0.00	0	0.5	0	1.5
	Right wingwall	0.00	0	0.5	0	1.5
	Scour/bank protection	0.00	0	2	0	6
	Bridge approach	0.00	1	1	0.5	3
	Total	980,000.00			81.5	219

NMPS = 81.5 / 219 = 0.372

Note that maintenance costs are only estimated for items where Ci = 2 or 3

BMC = 980,000.00

Assume the bridge in located on an east-west lateral road, therefore:

BRF = 0.75.

Assume the bridge has overall length of 80.0 meters and an overall width of 10 meters; therefore ECRP is Pesos 40.0 million.

The BNR calculated using the four tentative formulas are as follows:

No. 1 BNR = 0.372
No. 2 BNR = 0.279
No. 3 BNR = 0.272
No. 4 BNR = 11.388

3.3.8 Activities

Ensure that the data in the RBIA from the current bridge condition survey is complete and accurate for all regions.

The BMS Team Leader will monitor the data of data from the current bridge condition survey in the RBIA for completeness and accurate during the course of the survey as the data is loaded. If necessary, action will be taken to accelerate the progress of the survey or to correct inaccuracies in the data.

Set end dates for bridge condition data to be considered in BNR analysis.

The end dates for the bridge condition data to be considered in the BNR analysis need to be set. The start date will be set to April 30 for the previous year to exclude any prior condition survey data. The end date will be the date on which the RBIA database is assessed to be substantially complete with the current bridge condition survey data. This date will normally be April 22 of the current year.

Bridges in late regions will be omitted by this action.

Review BNR algorithms and set parameters and confirm algorithms and set parameters to be used in the BNR analysis.

The BMS Team Leader will review the BNR algorithms and set parameters and will determine any changes necessary to suit local requirements. It may be necessary make several BNR runs with varying algorithms or set parameters to decide the best combination to give appropriate results.

The BNR algorithms may be varied as discussed in Section 3.3.6.

The following set parameters may be changed:

- Bridge attribute weighting factors refer Table 3-2,
- Bridge route factors refer Table 3-3,

AC, the notional bridge replacement cost in Pesos per square meter of deck.

The BMS Team Leader will adequately document all changes made in the BNR algorithms and set parameters for future reference.

Undertake BNR analysis.

Guide to BMS Training Exercises Module 14

Undertake the BNR analysis for all national bridges as a single exercise.

The BNR analysis is undertaken only for those bridges that have a condition state of 2 or 3 for any defined attributes.

The BNR analysis screen of the BMS is illustrated in Figure 3-9.

Review BNR output for data errors.

Guide to BMS Training Exercises Module 16

The BNR output will be reviewed for data or calculation errors.

The Bridge Review Report (Report BRO_03) printed in descending order of BNR will be used to check that realistic values of NMPS, NMC, ECRP and BNR are returned for all included bridges. Refer Figure 3-10.

Rank the bridges based on BNR.

All bridges are ranked for priority using the BNR. The higher the ratio the greater the priority for maintenance or other activity.

The ranking of bridges would be undertaken as a countrywide exercise, to ensure that all bridges requiring intervention are ranked on a national basis.

The analysis will rank the bridges based on BNR. The bridge with the highest calculated BNR will be ranked 1; the bridge with the second highest calculated BNR will be ranked 2 and so on. Bridges with identical calculated BNR will be given the same ranking while the next ranking number would be skipped.

For example, the following bridges would be ranked as follows:

Bridge 1	BNR = 0.345	Rank = 234
Bridge 2	BNR = 0.343	Rank = 235
Bridge 3	BNR = 0.343	Rank = 235
Bridge 4	BNR = 0.343	Rank = 235
Bridge 5	BNR = 0.341	Rank = 238
Bridge 6	BNR = 0.340	Rank = 239

Figure 3-9
Screen Shot of BNR Analysis

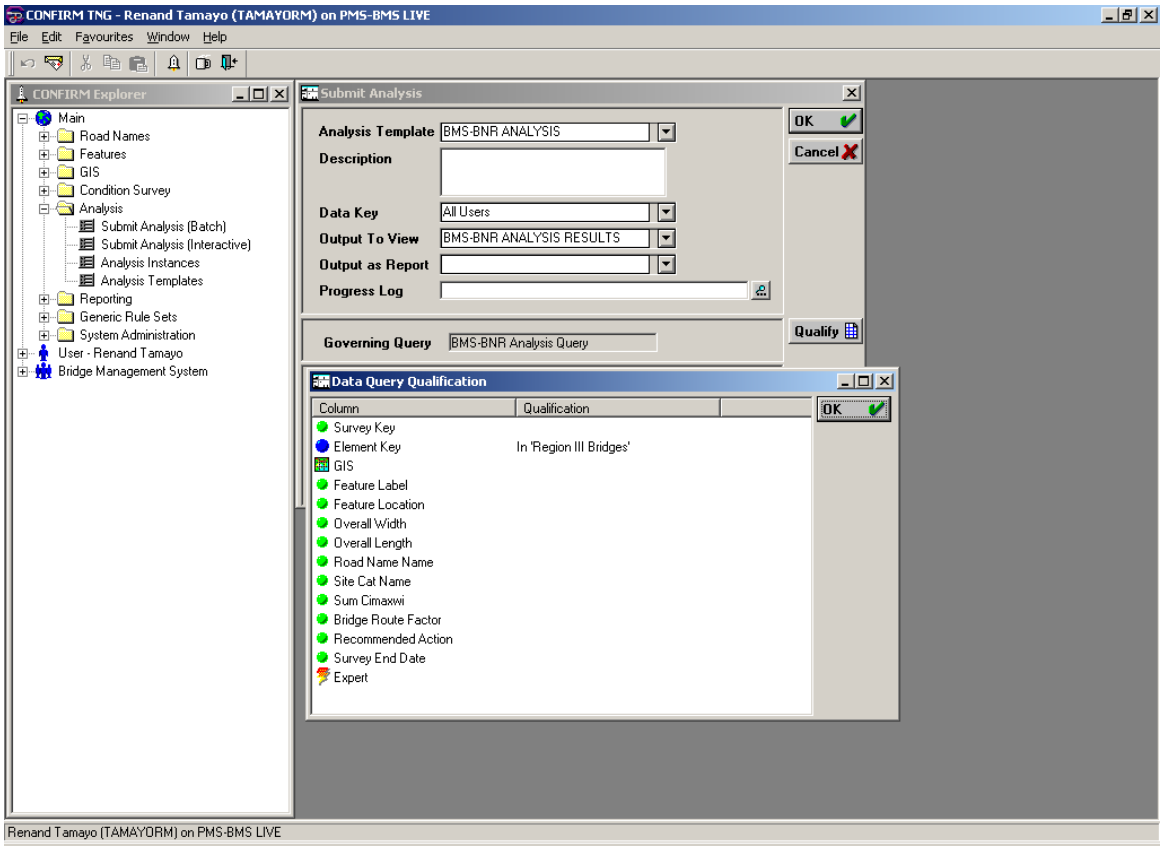
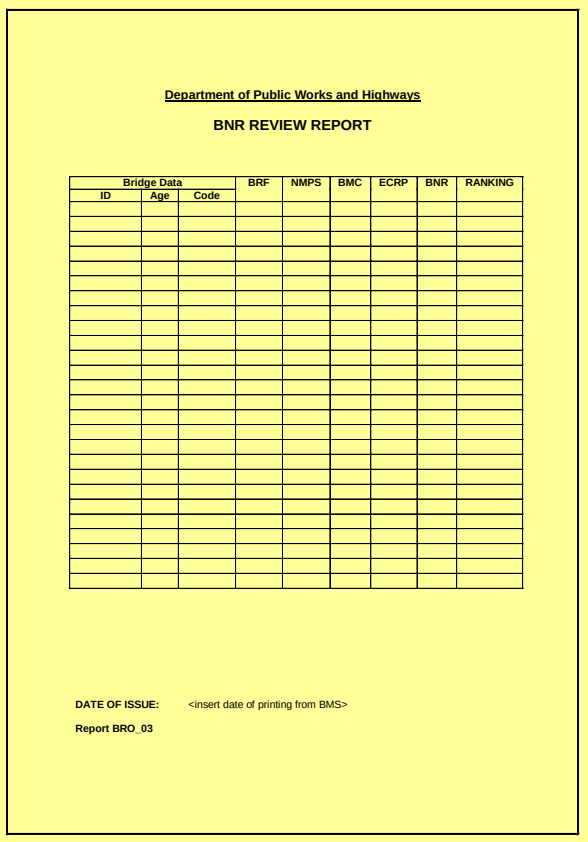


Figure 3-10
BNR Review Report



Department of Public Works and Highways

BNR REVIEW REPORT

Bridge Data			BRF	NMPS	BMC	ECRP	BNR	RANKING
ID	Age	Code						

DATE OF ISSUE: <insert date of printing from BMS>

Report BRO_03

3.4 Procedure A24 - Assess Routine Maintenance Requirements

3.4.1 Objectives.

To prepare schedules of the routine maintenance requirements of national bridges for budgeting purposes.

3.4.2 Definitions

Routine Maintenance — All routine and periodic maintenance to bridges undertaken using DPWH routine maintenance funds as defined by RMMS.

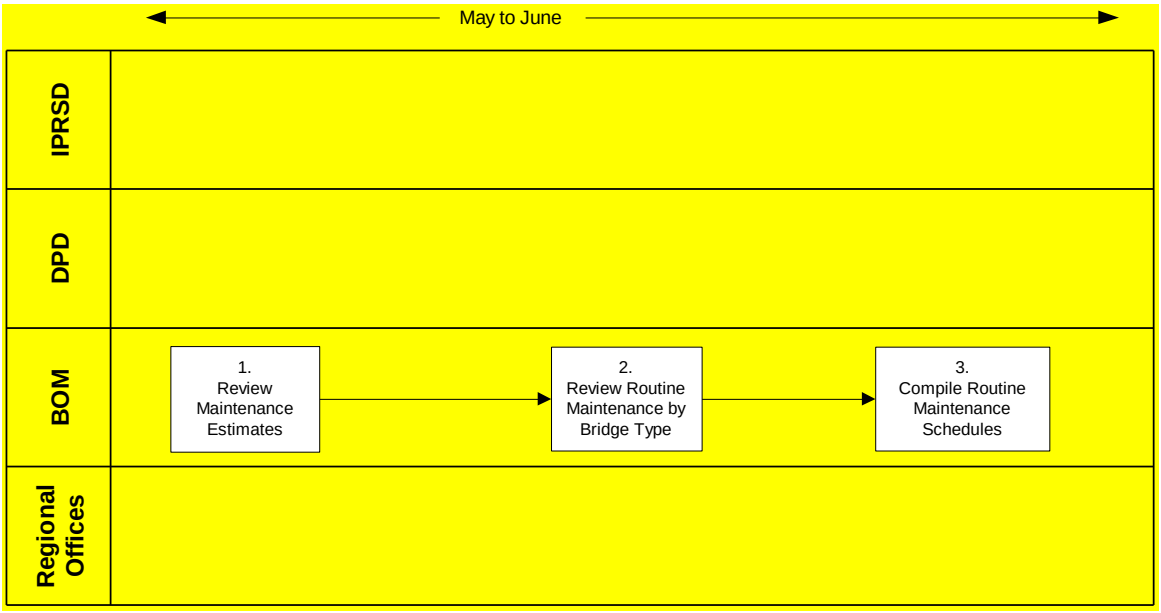
3.4.3 Application User Coordinators

Bureau of Maintenance (BOM)

3.4.4 Users

Bureau of Maintenance (BOM)
Regional Office Maintenance Divisions (ROMDs)

3.4.5 Workflow



Step 1 — Review Routine Maintenance Estimates

Step 2 — Review Routine Maintenance by Bridge Type

Step 3 — Compile Schedules of Routine Maintenance by country, region and engineering district.

3.4.6 Activities

Review Routine Maintenance Estimates

Availability of the historical routine maintenance costs data together with the bridge inventory data allows the BMS to carry out various verification processes to ensure that the estimated routine maintenance cost is reliable.

The following tests can be made on the estimates:

- Review the cost estimates using the estimates over the period of record.
- Review the cost estimates on a Peso per square meter of bridge deck area, to determine if there is a large variation between different bridges. For example, the unit cost of *Sweeping and cleaning of bridge deck* should be comparable for all bridges.
- Review routine maintenance costs need for bridges of similar type and condition to determine the variation in range of the data.

Review Routine Maintenance by Bridge Type

Availability of the bridge inventory data in the RBIA allows the BMS to be used to carry out various verification processes to ensure that the estimated routine maintenance cost is reliable.

The following tests can be made on the estimates:

- Check that the routine maintenance estimates are appropriate for the type of bridge. For example, *repairs to bailey bridges* in only applicable to *demountable (Bailey type)* bridges.

Compile Schedules of Routine Maintenance by country, region and engineering district.

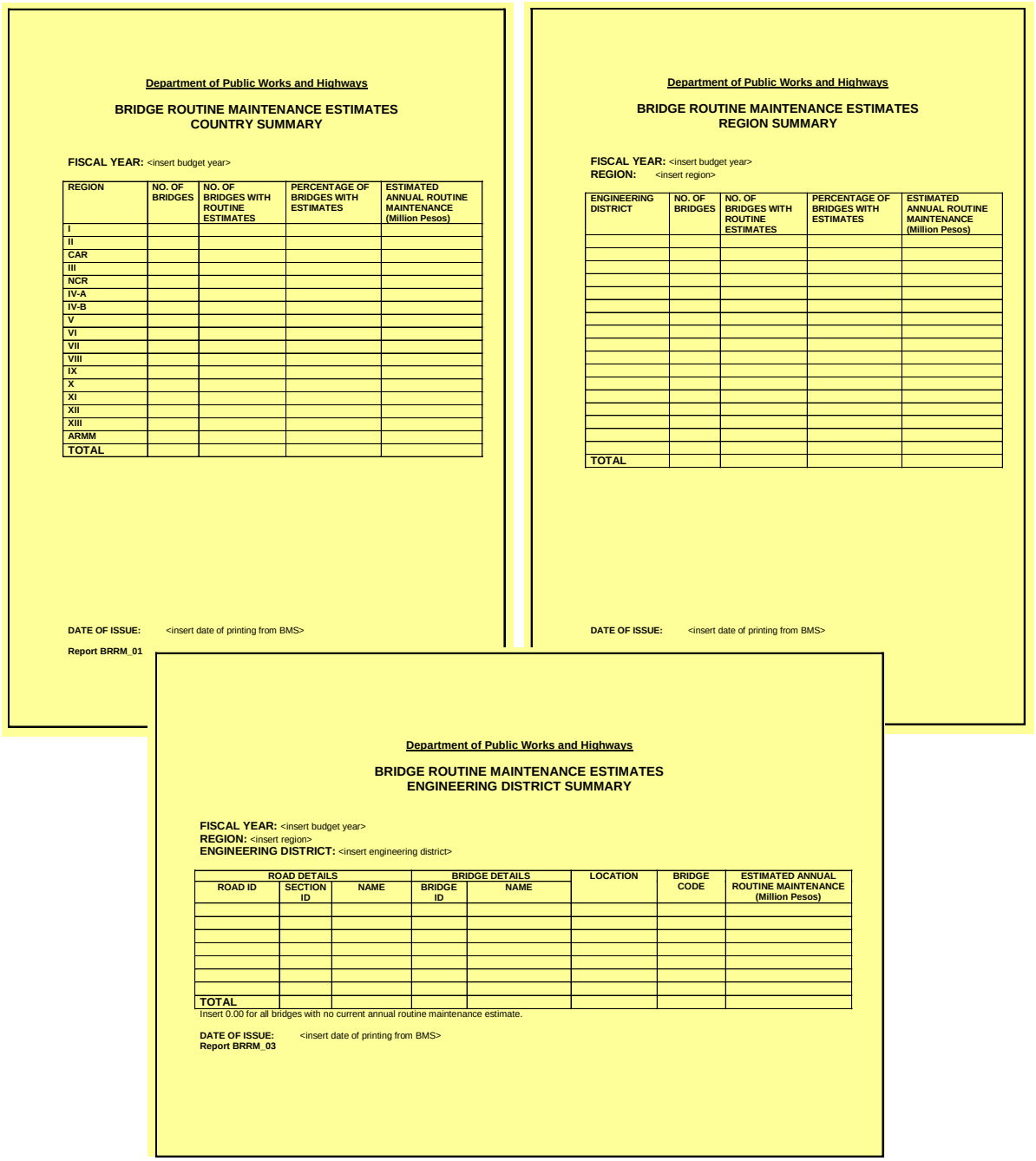
A number of reports have been designed to extract the routine maintenance data out from the database together with other bridge inventory and condition parameters.

The available reports are:

- Report BRM_01 Routine Maintenance Estimates, Country Summary,
- Report BRM_02 Routine Maintenance Estimates, Region Summary,
- Report BRM_03 Routine Maintenance Estimates, Engineering District Summary, and
- Report BRM_04 Routine Maintenance Estimates, Bridge Details.

Typical routine maintenance reports are illustrated in Figure 3-11.

Figure 3-11
Routine Maintenance Reports



Department of Public Works and Highways

BRIDGE ROUTINE MAINTENANCE ESTIMATES
COUNTRY SUMMARY

FISCAL YEAR: <insert budget year>

REGION	NO. OF BRIDGES	NO. OF BRIDGES WITH ROUTINE ESTIMATES	PERCENTAGE OF BRIDGES WITH ESTIMATES	ESTIMATED ANNUAL ROUTINE MAINTENANCE (Million Pesos)
I				
II				
CAR				
III				
NCR				
IV-A				
IV-B				
V				
VI				
VII				
VIII				
IX				
X				
XI				
XII				
XIII				
ARMM				
TOTAL				

DATE OF ISSUE: <insert date of printing from BMS>

Report BRRM_01

Department of Public Works and Highways

BRIDGE ROUTINE MAINTENANCE ESTIMATES
REGION SUMMARY

FISCAL YEAR: <insert budget year>
REGION: <insert region>

ENGINEERING DISTRICT	NO. OF BRIDGES	NO. OF BRIDGES WITH ROUTINE ESTIMATES	PERCENTAGE OF BRIDGES WITH ESTIMATES	ESTIMATED ANNUAL ROUTINE MAINTENANCE (Million Pesos)
TOTAL				

DATE OF ISSUE: <insert date of printing from BMS>

Department of Public Works and Highways

BRIDGE ROUTINE MAINTENANCE ESTIMATES
ENGINEERING DISTRICT SUMMARY

FISCAL YEAR: <insert budget year>
REGION: <insert region>
ENGINEERING DISTRICT: <insert engineering district>

ROAD DETAILS			BRIDGE DETAILS		LOCATION	BRIDGE CODE	ESTIMATED ANNUAL ROUTINE MAINTENANCE (Million Pesos)
ROAD ID	SECTION ID	NAME	BRIDGE ID	NAME			
TOTAL							

Insert 0.00 for all bridges with no current annual routine maintenance estimate.

DATE OF ISSUE: <insert date of printing from BMS>
Report BRRM_03

4 ENGINEERING INSPECTION PROCEDURES

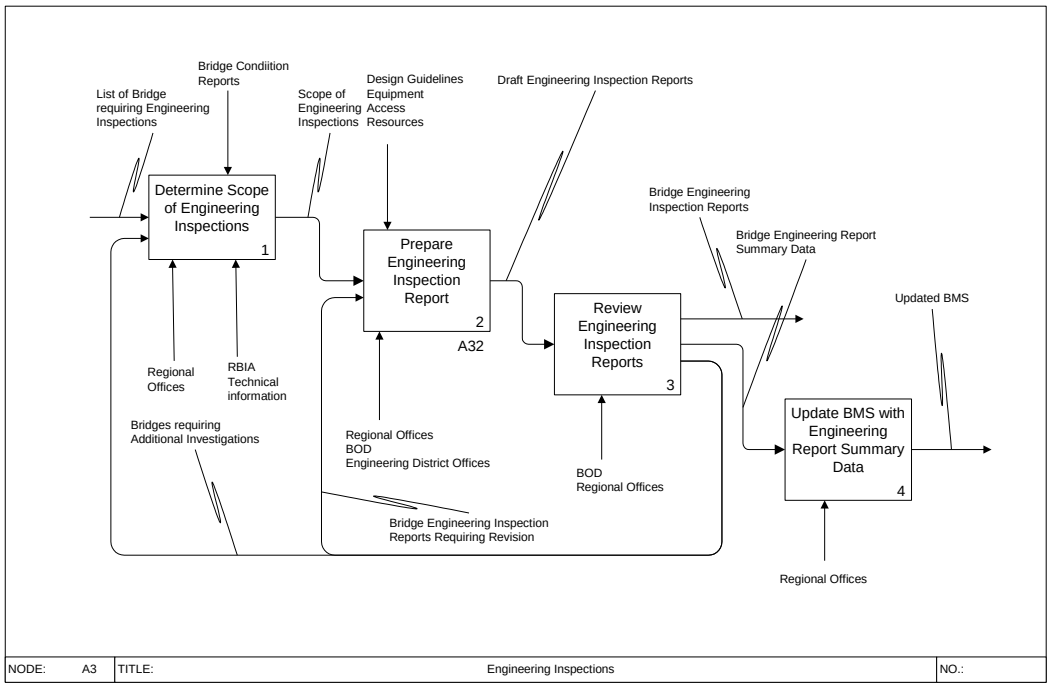
4.1 Overview

Engineering Inspections (Type 4) are an essential part of the BMS process to provide accurate assessments of the type of intervention required to each bridge and to correctly allocate the bridges requiring intervention into the major maintenance and network development streams.

The BMS can be used without the Engineering Inspection Data but the accuracy of the interventions determined without these inspections will not be sufficient to justify funding and to develop faith in the outputs of the BMS.

The process for Engineering Inspections is shown in Figure 4-1.

Figure 4-1
Engineering Inspections



4.2 Procedure A3 - Engineering Inspections

4.2.1 Objectives.

To provide a detailed engineering inspection of all bridges where intervention may be required, based on an annual bridge condition inspection, to confirm the type of intervention required, to determine the scope of work to rectify any defects and to provide a cost estimate of the recommended intervention.

4.2.2 Definitions

Bridge Engineer	A civil or structural engineer with extensive professional experience in the investigation and design of bridges.
Engineering Inspection	Inspections undertaken when required to provide further particular information about defects recorded in bridges during an annual bridge condition inspection.

4.2.3 Application User Coordinators

Bureau of Design (BOD)

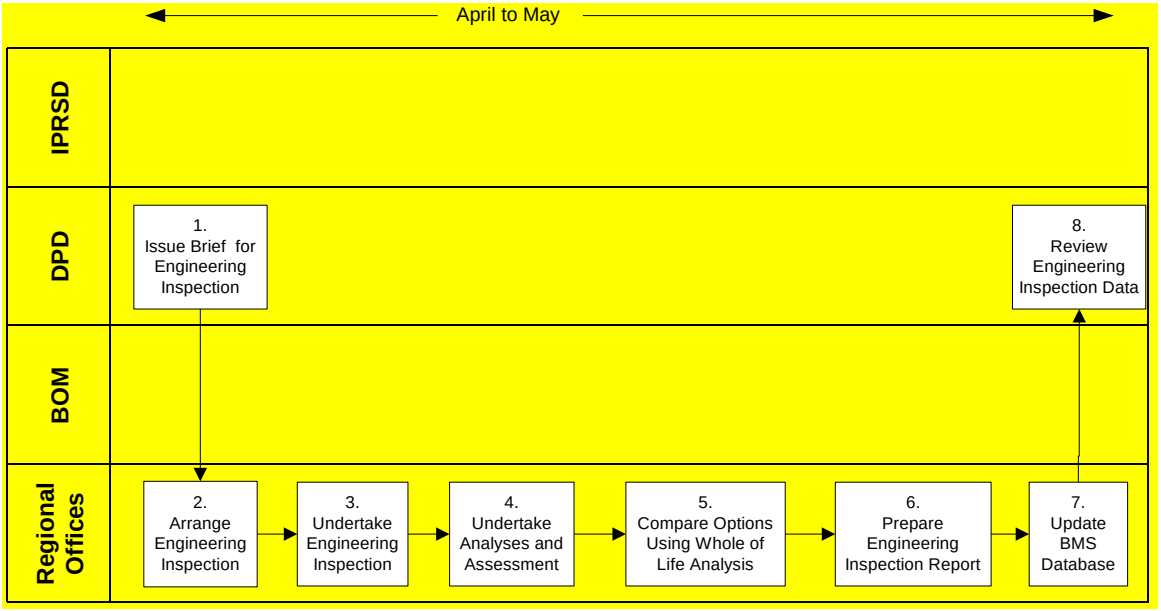
4.2.4 Users

Regional Offices Maintenance Divisions (ROMDs)
Regional Offices Design Divisions (RODDs)
Engineering Districts Offices (EDOs)

4.2.5 Workflow

The workflow for an engineering inspection report is shown in Figure 4-2.

Figure 4-2
Workflow for Engineering Inspection

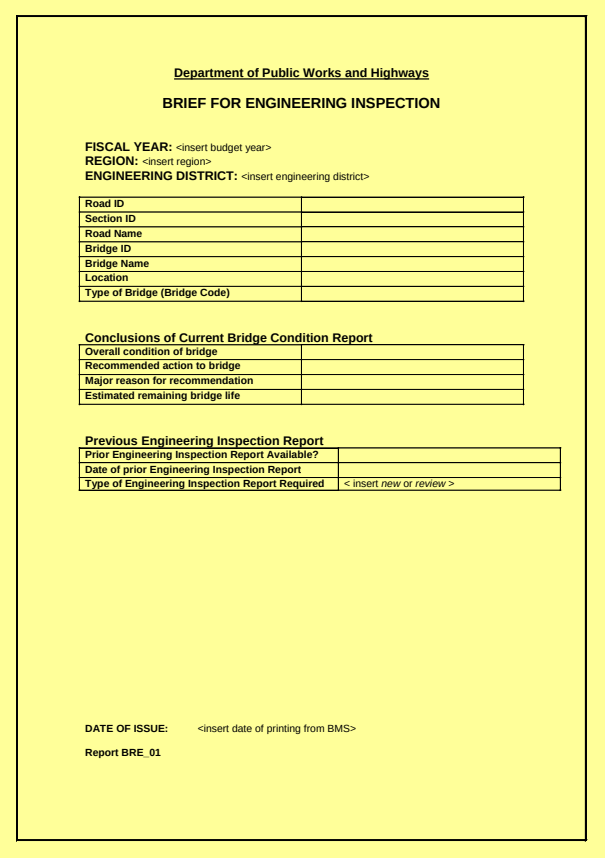


Step 1	Prepare brief for engineering inspection report.
Step 2	Arrange engineering inspection
Step 3	Undertake engineering inspection
Step 4	Undertake analyses and assessment
Step 5	Compare options using whole of life analysis
Step 6	Prepare engineering inspection report
Step 7	Update BMS database

4.2.6 Activities

Prepare brief for engineering inspection report.	The BMS Team Leader shall issue a Brief for Engineering Inspection for all bridges where the annual bridge condition survey reveal the presence of defined attributes with a condition state of 2 or 3. Refer Figure 4-3.

Figure 4-3
Brief for Engineering Inspection



Department of Public Works and Highways

BRIEF FOR ENGINEERING INSPECTION

FISCAL YEAR: <insert budget year>
REGION: <insert region>
ENGINEERING DISTRICT: <insert engineering district>

Road ID	
Section ID	
Road Name	
Bridge ID	
Bridge Name	
Location	
Type of Bridge (Bridge Code)	

Conclusions of Current Bridge Condition Report

Overall condition of bridge	
Recommended action to bridge	
Major reason for recommendation	
Estimated remaining bridge life	

Previous Engineering Inspection Report

Prior Engineering Inspection Report Available?	
Date of prior Engineering Inspection Report	
Type of Engineering Inspection Report Required	< insert *new* or *review* >

DATE OF ISSUE: <insert date of printing from BMS>

Report BRE_01

Form BRE_01

Engineering inspections are of two types:

- New – in the case of a bridge with newly reported defects, the engineering inspection shall comprise a full investigation of the bridge.
- Review – in this case, the inspections are a review of the prior engineering inspection report to confirm that the nature of the defects is unchanged and to update the cost of the recommended intervention.

The brief for engineering inspection shall list the type of engineering inspection required.

Arrange engineering inspection

The Regional Bridge Engineer shall review the Bridge Condition Report for all bridges where a brief for engineering inspection has been received and prepare a detailed scope of work for the engineering inspection.

The scope of the engineering inspection shall be defined to address all deteriorated attributes identified in the Bridge Condition Report. The scope shall also require a consideration into the adequacy of the existing bridge in terms of loading, width, capacity and closure.

The level of expertise required to undertake the engineering inspection shall be determined based on the nature and magnitude of the deterioration.

The Regional Office shall select the provider for the engineering inspection and shall make all arrangements for the inspection to proceed, including the provision of a bridge inspection vehicle and specialized testing equipment, if required.

Undertake engineering inspection

All necessary field investigations will be undertaken to document the extent and cause of the identified defects and to identify the type and extent of the possible rectification measures.

All investigations will be undertaken in accordance with the appropriate standard.

Undertake analyses and assessment

The nature and extent of the defects revealed by the field investigations will be analyzed to determine their adverse impact on the bridge structure and to assess options to address the defects.

All possible interventions will be considered for possible intervention to address the defects. Possible intervention include:

- Major maintenance to restore damaged structures to the as-new condition,
- Major maintenance including the replacement of deteriorated items with improved materials (e.g., the use of steel deck panels to replace deteriorated timber decks on demountable (Bailey type) bridges,
- Upgrading entailing extensive or expensive strengthening, retrofitting, widening and reconstruction of elements, or
- Replacement to replace a deteriorated bridge in its entirety.

Compare options using whole of life analyses

The concept of life cycle costing attempts to ensure that all appropriate future implications are taken into account when deciding present strategies. It is necessary to have a nominated life span in making these decisions but it must be remembered that this relates to a period for which the bridge will be needed, rather than a plan to actually replace the bridge at about that time. The nominated 'life' is therefore a notional target date up to which the bridge must remain viable.

Many bridges now 30 to 50 years old will receive work that will reset their expected life span to another 30 to 50, or even more, years.

The remaining life span of a bridge must be determined by an engineering inspection prior to any consideration of upgrading or replacement.

There is a range of options with different costs, serviceability and expected life span implications. Life cycle costing relates the cost of each option to the overall serviceability and required longevity of the structure for comparing the life cycle costs of optional management strategies.

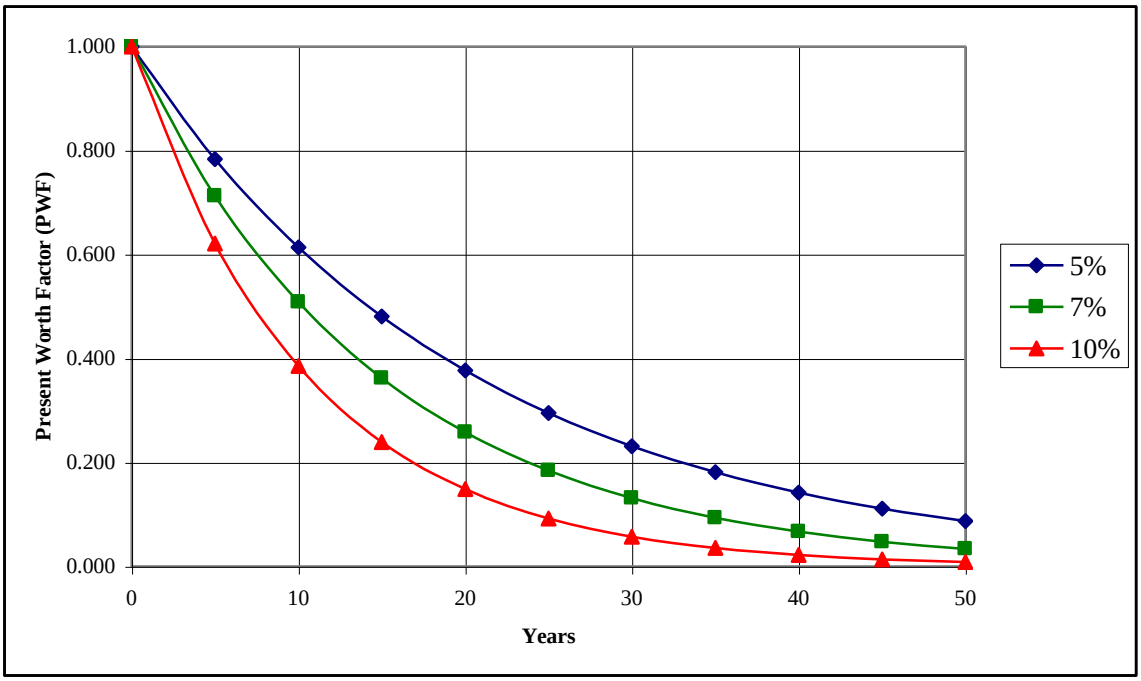
For each strategy, a program of activities is drawn up in which the timing and cost of each future action is nominated. The future cost of each action is then converted to its present worth value by multiplying by the appropriate present worth factor (PWF).

$$PWF(n) = 1/(1+i)^n$$

Where i is the real interest rate per annum,
n is the time to the future action, in years, and
$PWF(n)$ is the present worth factor of a future action undertaken at time n.

The present worth factor is shown in Figure 4-4.

Figure 4-4
Present Worth Factor



The sum of all these present worth values is then converted to an equivalent annual uniform cost over the expected life of the bridge by multiplying by the capital recovery factor CRF.

$$CRF(N) = i(1+i)^N / \left((1+i)^N - 1\right)$$

Where *i* is the real interest rate per annum
N is the expected life span of the bridge, in years, and
CRF(N) is the capital recovery factor for the expected life span (N).

The capital recovery factor is shown in Figure 4-5.

Finally, the annual cost of maintenance must be added.

The total annual cost is given by:

$$TAC = CRF(N)\sum_{k=1}^{i}\{(\text{cost of action k})PWF(n_k)\} + \text{annual maintenance cost}$$

Where *TAC* is the total annual cost, and

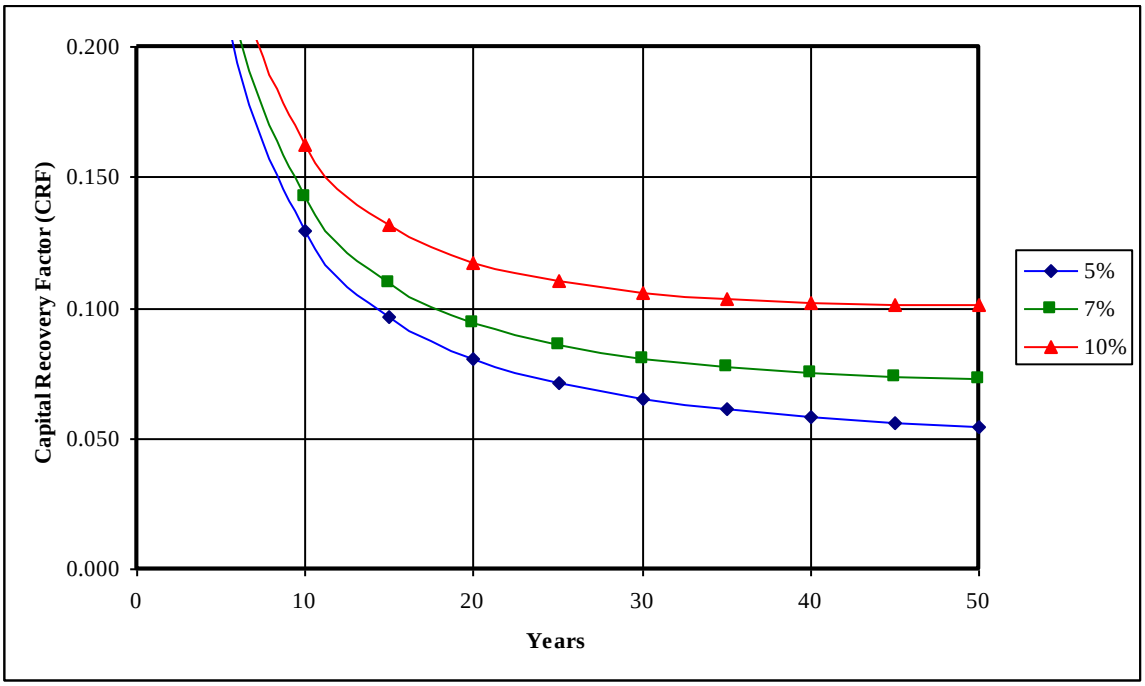
k is each maintenance item

The option with the lowest total annual cost is the most economic.

Some aspects to be considered in the analysis include:

- Real rate of interest - any extra funds spent now have a real cost of interest which is the difference between the inflation rate (of construction costs) and general interest rates. Typically, a figure of about 7% may be used with 5% and 10% also analyzed to check sensitivity to interest rate variation. The economic analysis is sensitive to the real rate of interest used with high rates favoring options with low initial cost but high costs incurred later,
- Routine and major maintenance - these are necessary for the continued serviceability of any structure but certain specific actions can reduce maintenance costs. For example, provision of a steel deck on a Bailey bridge saves regular maintenance and future replacement of a timber deck.
- Rehabilitation and enhancement may bring other benefits beyond the narrow scope of the life cycle cost analysis. For example, the removal of a load limit, a smoother running surface and an increase in width all result in benefits to road users

Figure 4-5
Capital Recovery Factor



To illustrate life cycle costing, consider a 10-year-old timber bridge having two spans of 6 m and a width of 7 m.

A detailed inspection showed that the piles on the pier were rotted at ground level and required repair within two years, while some of the timber corbels were split and needed banding as soon as possible. The inspection also showed that the timber deck was reasonably sound but would require replacement in five years time.

The estimated cost of each activity (in current values) is shown in Table 4-1 together with the present worth factor (assuming a real interest rate of 7%) and the present worth of costs. The total present worth of costs is P178,500.00.

Table 4-1
Present Worth of Future Maintenance Expenditures

Maintenance Activity	Time Years	Estimated Cost P	PWF	Present Worth P
Repair Corbel	0	33,000.00	1.000	33,000.00
Repair Piles	2	85,000.00	0.873	74,200.00
Deck replacement	5	100,000.00	0.713	71,300.00
TOTAL PRESENT WORTH				**178,500.00**

The expected life span with maintenance is 10 years, making a total expected life span of 15 years. The capital recovery factor for 15 years, at a real interest rate of 7% per annum, is 0.110.

The equivalent annual uniform cost is therefore:

P178,500.00 x 0.110 = P 19,600.00 per year

To this must be added an estimated annual maintenance cost of P20,000.00, making a total cost of:

P19,600.00 + P20,000.00 = P39,600.00 per year

An alternative is replacement by a standard concrete girder bridge, at an estimated construction cost of P4.2 million, with no expected rehabilitation actions over an expected life span of 50 years.

The total present worth of costs is simply the construction cost of P4.2 million. The equivalent annual uniform cost is:

P4,200,000 x 0.072 = P304,000.00 per year

The estimated annual maintenance cost is P6,000.00.

Therefore, the total annual cost is:

P304,000.00 + P6,000.00 = P310,000.00

Prepare engineering inspection report

A full technical report would be prepared at the completion of the engineering inspection to fully document the work undertaken.

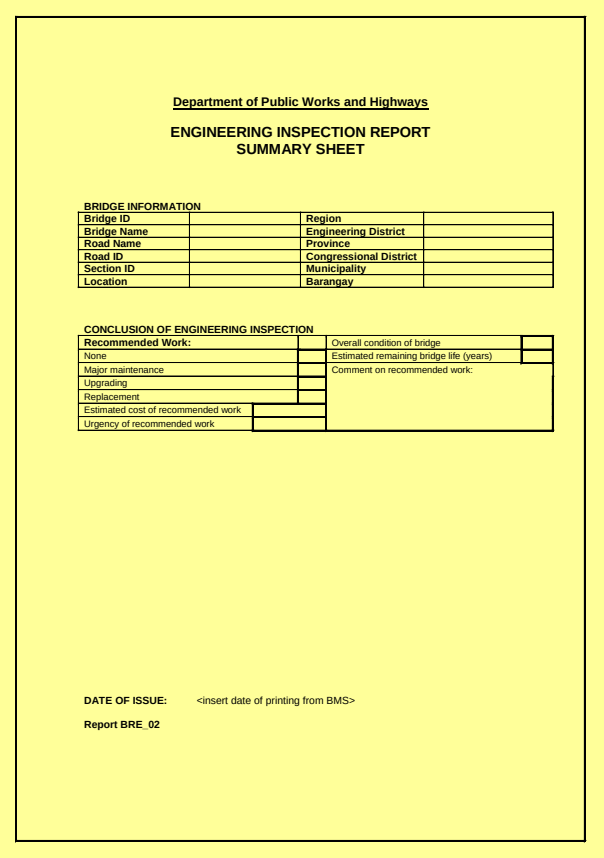
The technical report will consist of the following section:

- Discussion of bridge condition report,
- Investigations undertaken,

- Analyses undertaken,
- Options considered,
- Whole of life analysis of options,
- Cost estimates,
- Recommendations, and
- Engineering Inspection Report Summary Sheet (Refer Figure 4-6.

The full technical report will be held in digital format in the DPWH Document Management System and linked to the bridge data in the RBIA.

Figure 4-6
Engineering Inspection Report Summary Sheet



Department of Public Works and Highways

ENGINEERING INSPECTION REPORT
SUMMARY SHEET

BRIDGE INFORMATION

Bridge ID		Region	
Bridge Name		Engineering District	
Road Name		Province	
Road ID		Congressional District	
Section ID		Municipality	
Location		Barangay	

CONCLUSION OF ENGINEERING INSPECTION

Recommended Work:		Overall condition of bridge	
None		Estimated remaining bridge life (years)	
Major maintenance		Comment on recommended work:	
Upgrading			
Replacement			
Estimated cost of recommended work			
Urgency of recommended work			

DATE OF ISSUE: <insert date of printing from BMS>

Report BRE_02

Update BMS database The regional office will record the summary information from the engineering inspection in the RBIA.

5 BMS REPORTING PROCEDURES

5.1 Overview

The reporting functions of the BMS are of prime importance to the users of the BMS data and outputs as this is the information used to assist them in planning and other activities.

The RBIA has an in built Reporting module that allows DPWH to develop and format any report to suit their requirements.

5.2 Procedure A4 – BMS Reporting

5.2.1 Objectives.

To provide the information required by BMS users in the form required for planning and programming bridge activities.

5.2.2 Definitions

Bridge Major Maintenance Program	A program of required works for bridge asset preservation, ranked by need.
Bridge Network Development Program	A program of required works for bridge upgrading and replacement, requiring capital works funding, and ranked by need.

5.2.3 Application User Coordinators

Planning Service (PS)

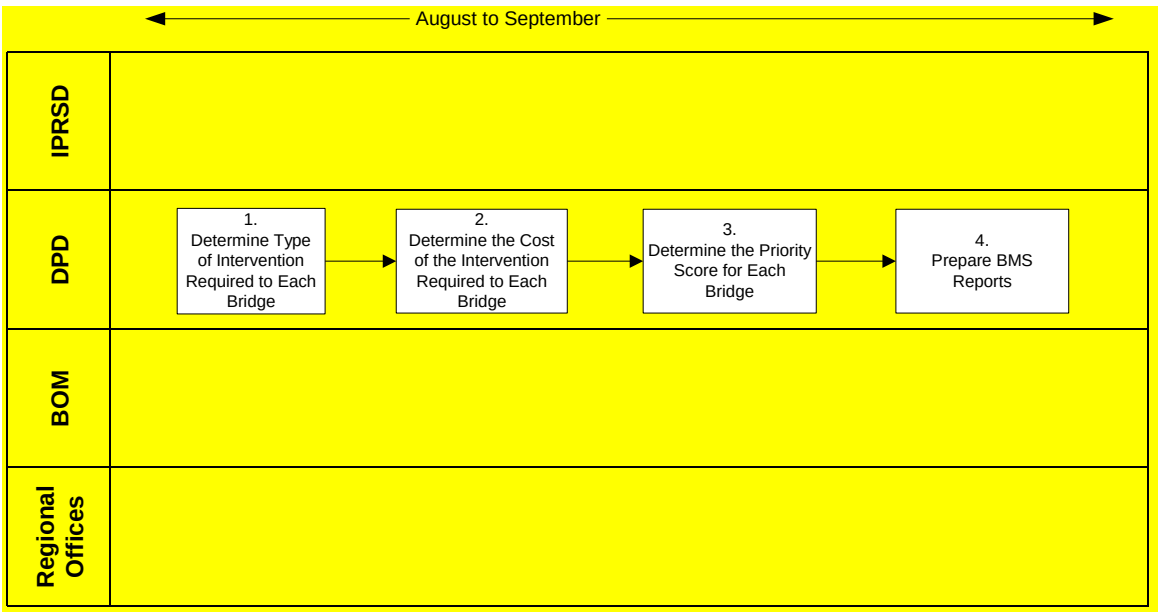
5.2.4 Users

Planning Service (PS)
Regional Offices (ROs)

5.2.5 Workflow

The workflow for BMS Reporting is shown in Figure 5-1.

Figure 5-1
Workflow for BMS Reporting



Step 1 — Determine type of intervention required to each bridge.

Step 2 — Determine the cost of the required intervention to each bridge.

Step 3 — Determine the priority score for each bridge in the major maintenance and network development programs.

Step 4 — Prepare BMS reports.

5.2.6 Activities

Determine type of intervention required to each bridge

The type of intervention to each bridges is determined, based on the following factors:

- Recommendation of bridge inspector,
- The calculated BNR for the bridge,
- The magnitude of the major maintenance cost required to restore the bridge, and
- Any current Engineering Inspection Report.

The process followed to determine the type of intervention is shown in Figure 5-2.

The calculated BNR for all bridges with a recorded condition state for any defined attribute of 2 or 3, and possibly requiring intervention, are listed in order of increasing rank, for the categories of intervention recommended by the bridge inspector.

A sample listing of bridges with calculated BNR values and other data is included in Table 5-1.

Figure 5-2
Determine Type of Intervention

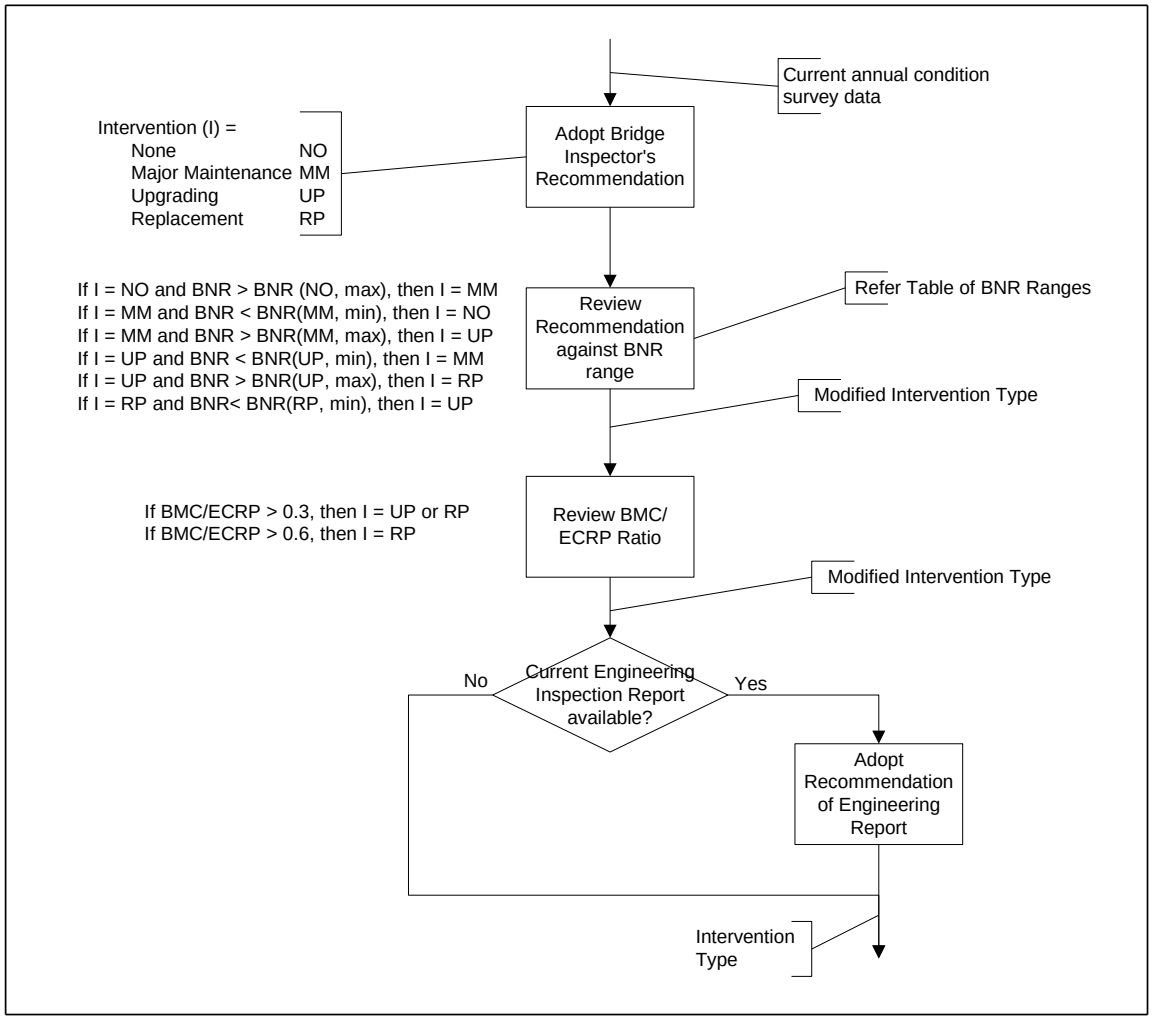


Table 5-1
BNR Analysis

Bridge ID	Code	Lanes	Length	BMC	BNR	ECRP	BIR
B00146LZ	CGR	2	56.6	40,000.00	0.014	23,489,000.00	MAJOR
B00085LZ	SGR	2	28.6	50,000.00	0.027	12,584,000.00	MAJOR
B00129LZ	CGR	2	16.6	80,000.00	0.027	7,802,000.00	MAJOR
B00007LZ	CGR	2	28.6	60,000.00	0.028	12,727,000.00	MAJOR
B00061LZ	CSL	2	6.6	200,000.00	0.028	2,970,000.00	MAJOR
B00055LZ	CGR	4	114.4	550,000.00	0.032	93,808,000.00	MAJOR
B00024LZ	CGR	2	19.8	56,000.00	0.035	7,821,000.00	MAJOR
B00124LZ	CGR	2	24.2	30,000.00	0.036	11,495,000.00	MAJOR
B00020LZ	CGR	2	11.9	40,000.00	0.043	4,641,000.00	MAJOR
B00030LZ	MAR	2	9.0	18,000.00	0.043	3,690,000.00	MAJOR
B00031LZ	CGR	2	22.5	532,000.00	0.043	9,337,500.00	MAJOR
B00063LZ	CGR	2	22.6	5,000.00	0.043	10,057,000.00	MAJOR
B00119LZ	CGR	2	15.6	100,000.00	0.043	7,566,000.00	MAJOR

B00133LZ	CGR	2	28.6	210,000.00	0.043	13,442,000.00	MAJOR
B00046LZ	CGR	2	29.9	12,000.00	0.046	11,960,000.00	MAJOR
B00095LZ	CAR	2	37.0	54,000.00	0.052	20,720,000.00	MAJOR
B00074LZ	CGR	2	81.6	80,000.00	0.054	38,760,000.00	MAJOR
B00025LZ	CAR	2	86.8	27,000.00	0.054	36,022,000.00	MAJOR
B00003LZ	STR	2	45.3	23,000.00	0.057	18,120,000.00	MAJOR
B00010LZ	SGR	2	19.8	160,000.00	0.063	8,316,000.00	MAJOR
B00069LZ	SGR	2	16.6	260,000.00	0.071	7,802,000.00	MAJOR
B00018LZ	CGR	2	16.5	40,000.00	0.071	7,260,000.00	MAJOR
B00088LZ	CGR	2	36.1	70,000.00	0.071	17,147,500.00	MAJOR
B00105LZ	CGR	2	12.6	80,000.00	0.071	6,930,000.00	MAJOR
B00042LZ	CGR	2	38.0	75,000.00	0.071	16,910,000.00	MAJOR
B00102LZ	SCS	2	156.2	400,000.00	0.075	92,158,000.00	MAJOR
B00131LZ	CSL	2	30.6	270,000.00	0.076	14,076,000.00	MAJOR
B00130LZ	CSL	2	30.6	270,000.00	0.079	14,994,000.00	MAJOR
B00006LZ	CGR	2	75.5	271,000.00	0.084	31,332,500.00	MAJOR
B00051LZ	SGR	2	29.3	17,000.00	0.084	12,306,000.00	MAJOR
B00068LZ	CGR	2	9.6	23,000.00	0.085	3,792,000.00	MAJOR
B00101LZ	CGR	2	12.6	205,000.00	0.085	5,229,000.00	MAJOR
B00115LZ	CGR	2	22.0	160,000.00	0.085	10,450,000.00	MAJOR
B00053LZ	SGR	2	90.0	42,000.00	0.086	39,600,000.00	MAJOR
B00080LZ	CGR	2	11.4	84,000.00	0.088	3,990,000.00	MAJOR
B00112LZ	CGR	2	27.8	125,000.00	0.092	14,456,000.00	MAJOR
B00113LZ	CGR	2	19.4	109,000.00	0.092	9,894,000.00	MAJOR
B00005LZ	SGR	2	44.1	1,774,000.00	0.094	18,522,000.00	MAJOR
B00116LZ	CGR	2	77.4	147,500.00	0.096	36,765,000.00	MAJOR
B00004LZ	CGR	2	15.4	72,000.00	0.099	6,468,000.00	MAJOR
B00071LZ	SGR	2	16.6	135,000.00	0.099	7,802,000.00	MAJOR
B00033LZ	CGR	2	21.6	328,000.00	0.103	8,856,000.00	MAJOR
B00039LZ	CAR	2	45.6	16,000.00	0.104	28,728,000.00	MAJOR
B00106LZ	SGR	2	36.5	220,000.00	0.107	18,980,000.00	MAJOR
B00001LZ	CGR	2	48.8	68,000.00	0.107	20,252,000.00	MAJOR
B00077LZ	CGR	2	13.6	40,000.00	0.110	4,964,000.00	MAJOR
B00008LZ	CGR	2	21.4	371,000.00	0.113	9,416,000.00	MAJOR
B00092LZ	CGR	2	18.6	50,000.00	0.113	10,788,000.00	MAJOR
B00086LZ	SGR	2	33.6	206,000.00	0.117	16,128,000.00	MAJOR
B00103LZ	CAR	2	31.5	198,000.00	0.119	18,427,500.00	MAJOR
B00122LZ	CGR	2	27.6	50,000.00	0.120	12,420,000.00	MAJOR
B00110LZ	CGR	2	28.6	130,000.00	0.121	14,014,000.00	MAJOR
B00034LZ	CGR	2	15.7	415,000.00	0.128	6,908,000.00	MAJOR
B00141LZ	CGR	2	28.6	260,000.00	0.128	13,585,000.00	MAJOR
B00152LZ	CGR	2	22.6	160,000.00	0.128	10,622,000.00	MAJOR
B00135LZ	CGR	2	199.5	1,050,000.00	0.130	95,760,000.00	MAJOR
B00002LZ	CGR	2	24.6	290,000.00	0.133	13,653,000.00	MAJOR
B00012LZ	CGR	2	36.7	126,000.00	0.136	19,084,000.00	MAJOR
B00054LZ	CGR	2	30.6	30,000.00	0.140	11,628,000.00	MAJOR
B00093LZ	CGR	2	19.8	160,000.00	0.142	11,385,000.00	MAJOR
B00029LZ	SGR	2	84.6	355,000.00	0.149	37,647,000.00	MAJOR
B00097LZ	CGR	2	12.6	80,000.00	0.151	6,363,000.00	MAJOR
B00147LZ	CAR	2	55.0	90,000.00	0.154	22,275,000.00	MAJOR
B00128LZ	CGR	2	24.6	120,000.00	0.155	11,685,000.00	MAJOR
B00048LZ	CGR	2	15.5	19,000.00	0.156	8,602,500.00	MAJOR
B00142LZ	CGR	2	16.2	130,000.00	0.156	7,614,000.00	MAJOR
B00073LZ	CGR	4	45.6	480,000.00	0.175	36,024,000.00	MAJOR
B00026LZ	STR	2	70.6	300,000.00	0.176	26,122,000.00	MAJOR
B00137LZ	CGR	2	15.5	178,000.00	0.184	7,285,000.00	MAJOR
B00062LZ	CGR	2	30.6	175,000.00	0.187	13,770,000.00	MAJOR
B00121LZ	CTR	2	66.6	240,000.00	0.188	32,301,000.00	MAJOR
B00145LZ	SBY	1	30.5	290,000.00	0.190	6,100,000.00	MAJOR
B00081LZ	CGR	2	6.6	36,000.00	0.199	2,244,000.00	MAJOR
B00126LZ	CGR	4	18.9	72,000.00	0.199	13,702,500.00	MAJOR

B00021LZ	CSL	2	6.0	75,000.00	0.205	1,980,000.00	MAJOR
B00084LZ	CGR	2	19.4	85,000.00	0.213	9,021,000.00	MAJOR
B00060LZ	CGR	2	25.6	135,000.00	0.214	10,496,000.00	MAJOR
B00056LZ	CGR	2	24.6	40,000.00	0.222	11,316,000.00	MAJOR
B00091LZ	CGR	2	37.5	200,000.00	0.240	21,750,000.00	MAJOR
B00139LZ	CGR	2	12.6	185,000.00	0.241	4,977,000.00	MAJOR
B00108LZ	CGR	2	24.6	48,000.00	0.249	11,070,000.00	MAJOR
B00028LZ	CSL	2	6.0	35,000.00	0.258	1,980,000.00	MAJOR
B00125LZ	CGR	2	36.6	20,000.00	0.259	15,189,000.00	MAJOR
B00052LZ	CGR	4	30.6	250,000.00	0.289	25,092,000.00	MAJOR
B00144LZ	SOS	2	36.4	450,000.00	0.290	13,468,000.00	MAJOR
B00082LZ	NGR	2	25.6	115,000.00	0.298	11,392,000.00	MAJOR
B00009LZ	CGR	2	22.0	71,000.00	0.302	10,120,000.00	MAJOR
B00043LZ	CGR	2	21.0	90,000.00	0.324	9,345,000.00	MAJOR
B00011LZ	CGR	2	10.5	470,000.00	0.326	5,827,500.00	MAJOR
B00149LZ	STR	2	175.2	195,000.00	0.331	107,748,000.00	MAJOR
B00096LZ	SGR	2	9.5	130,000.00	0.340	4,227,500.00	MAJOR
B00047LZ	CGR	4	45.6	195,000.00	0.345	37,392,000.00	MAJOR
B00087LZ	SGR	2	40.6	470,000.00	0.348	18,879,000.00	MAJOR
B00136LZ	STR	2	95.5	666,000.00	0.366	47,750,000.00	MAJOR
B00058LZ	CGR	4	27.6	250,000.00	0.369	22,632,000.00	MAJOR
B00013LZ	STR	2	292.9	1,435,000.00	0.376	143,521,000.00	MAJOR
B00094LZ	SGR	2	21.3	120,000.00	0.384	9,585,000.00	MAJOR
B00037LZ	SBY	1	10.0	53,000.00	0.393	1,950,000.00	MAJOR
B00134LZ	SBY	1	21.3	182,500.00	0.858	5,751,000.00	MAJOR
B00148LZ	CGR	2	120.6	5,160,000.00	0.144	60,903,000.00	REPLACE
B00107LZ	CGR	2	21.6	90,000.00	0.178	10,152,000.00	REPLACE
B00079LZ	STR	1	22.0	260,000.00	0.531	5,500,000.00	REPLACE
B00118LZ	TGR	1	9.0	350,000.00	0.676	1,710,000.00	REPLACE
B00090LZ	CGR	2	63.6	20,640,000.00	0.900	29,892,000.00	REPLACE
B00019LZ	SGR	2	101.1	12,360,000.00	1.000	50,550,000.00	REPLACE
B00014LZ	CGR	2	22.8	0.00	0.000	10,146,000.00	ROUTINE
B00016LZ	CSL	2	6.0	0.00	0.000	2,910,000.00	ROUTINE
B00023LZ	CSL	2	16.6	0.00	0.000	8,715,000.00	ROUTINE
B00027LZ	SGR	2	19.1	0.00	0.000	7,926,500.00	ROUTINE
B00032LZ	SBY	2	150.0	0.00	0.000	63,000,000.00	ROUTINE
B00036LZ	CAR	2	27.6	0.00	0.000	15,318,000.00	ROUTINE
B00041LZ	OGR	2	76.6	0.00	0.000	34,853,000.00	ROUTINE
B00044LZ	CGR	2	56.6	0.00	0.000	23,772,000.00	ROUTINE
B00045LZ	SBY	2	25.2	0.00	0.000	9,324,000.00	ROUTINE
B00049LZ	CGR	2	36.6	0.00	0.000	20,130,000.00	ROUTINE
B00050LZ	CGR	2	100.9	0.00	0.000	59,026,500.00	ROUTINE
B00057LZ	CGR	2	20.7	0.00	0.000	9,936,000.00	ROUTINE
B00059LZ	CGR	2	6.0	0.00	0.000	2,580,000.00	ROUTINE
B00076LZ	CGR	2	17.5	0.00	0.000	8,225,000.00	ROUTINE
B00078LZ	CGR	2	9.6	0.00	0.000	4,176,000.00	ROUTINE
B00089LZ	CGR	2	20.1	0.00	0.000	8,040,000.00	ROUTINE
B00098LZ	SGR	2	184.5	0.00	0.000	83,947,500.00	ROUTINE
B00099LZ	MAR	2	51.0	0.00	0.000	28,305,000.00	ROUTINE
B00100LZ	CSL	2	19.2	0.00	0.000	8,064,000.00	ROUTINE
B00104LZ	CGR	4	24.9	0.00	0.000	21,040,500.00	ROUTINE
B00109LZ	SGR	2	9.7	0.00	0.000	4,801,500.00	ROUTINE
B00120LZ	CGR	2	7.6	0.00	0.000	3,610,000.00	ROUTINE
B00127LZ	CGR	2	7.6	0.00	0.000	5,700,000.00	ROUTINE
B00132LZ	CGR	2	15.6	0.00	0.000	7,332,000.00	ROUTINE
B00140LZ	CGR	2	27.6	0.00	0.000	13,110,000.00	ROUTINE
B00151LZ	CGR	2	24.6	0.00	0.000	10,824,000.00	ROUTINE
B00038LZ	CGR	2	156.6	0.00	0.002	67,338,000.00	ROUTINE
B00017LZ	CGR	4	12.6	0.00	0.007	10,080,000.00	ROUTINE
B00040LZ	STR	2	225.6	0.00	0.009	78,960,000.00	ROUTINE
B00072LZ	SGR	2	34.6	20,000.00	0.013	16,089,000.00	ROUTINE

B00065LZ	SGR	2	31.6	0.00	0.014	13,904,000.00	ROUTINE
B00067LZ	SGR	2	22.6	0.00	0.014	10,735,000.00	ROUTINE
B00035LZ	CSL	2	6.5	30,000.00	0.019	2,925,000.00	ROUTINE
B00064LZ	CGR	2	42.6	0.00	0.036	18,531,000.00	ROUTINE
B00022LZ	CGR	2	12.0	0.00	0.043	5,700,000.00	ROUTINE
B00075LZ	CGR	2	10.0	8,000.00	0.043	4,500,000.00	ROUTINE
B00066LZ	SGR	2	16.6	10,000.00	0.044	7,885,000.00	ROUTINE
B00070LZ	CSL	2	7.1	34,000.00	0.057	3,408,000.00	ROUTINE
B00015LZ	CGR	2	9.6	60,000.00	0.059	4,992,000.00	ROUTINE
B00143LZ	CAR	2	30.0	295,000.00	0.060	12,300,000.00	ROUTINE
B00150LZ	CGR	2	7.6	0.00	0.106	3,420,000.00	ROUTINE
B00117LZ	STR	2	50.8	0.00	0.126	24,384,000.00	ROUTINE
B00083LZ	SGR	2	16.1	107,000.00	0.234	7,567,000.00	ROUTINE
B00114LZ	CGR	2	24.0	1,090,000.00	0.248	9,360,000.00	UPGRADE
B00123LZ	CSL	2	12.8	710,000.00	0.595	4,736,000.00	UPGRADE

Code Indicates type of construction of bridge
BMC Estimates repair cost from Annual condition Survey
ECRP Estimated bridge replacement cost
BIR Bridge Inspector's Recommendation in Annual Condition Survey

The BNR ranges for all bridges with a particular recommendation in Table 5-1 are plotted in series as shown in Figure 5-3.

It is seen that the BNR curves for each type of intervention fall on curves over a wide range of BNR. For example, the range in BNR for the major maintenance intervention is 0.014 to 0.858.

BMS Operation and User Manual, Volume 1 – Operation Guide

These curves will be used to modify the BNR ranges for intervention types, included in Table 6-1 of Volume 1, based on experience with use of the BMS.

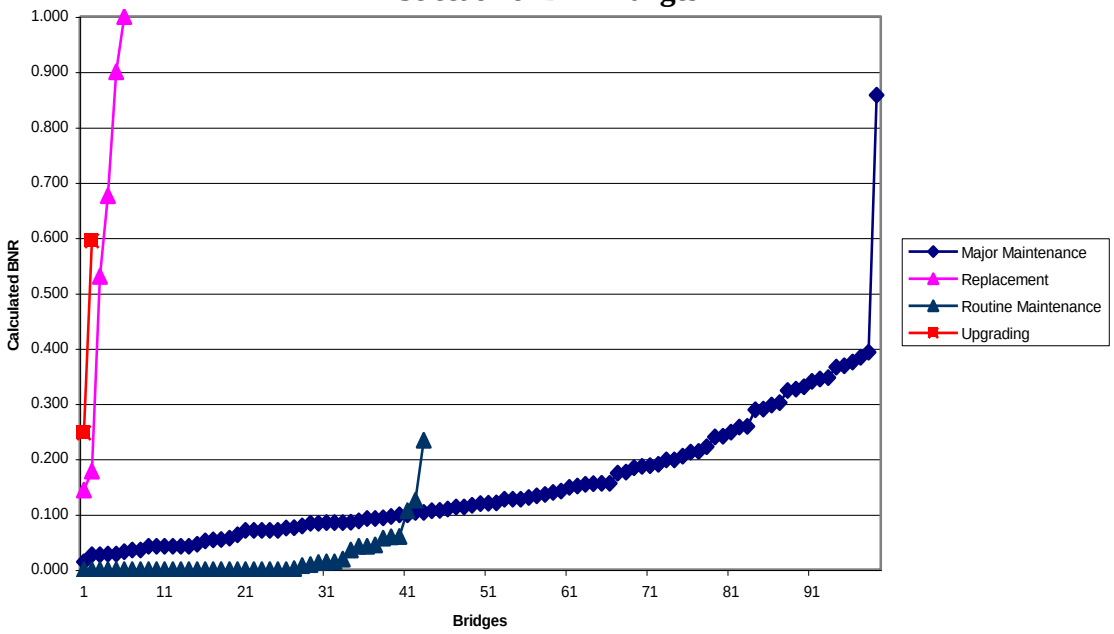
For example, if the major maintenance program becomes very large due to a large number of bridges with minor defects being included, the lower limit of the BNR range for major maintenance could be raised to exclude these non-urgent bridges.

The intervention type is also checked against the cost of the work. For example, if the cost of recommended major maintenance were more than 60% of the estimated replacement cost of the bridge, the intervention type would be upgraded to replacement in lieu of major maintenance.

The recommendation of a current Engineering Inspection Report will override the recommendation based on the Annual Condition Inspection data as this is based on a more comprehensive investigation of the bridge defects.

For example, if the Annual Condition Inspection data recommends major maintenance but the Engineering Inspection Report of the reported defects recommends routine maintenance only, then the type of intervention would be lowered from major maintenance to routine maintenance only.

Figure 5-3
Selection of BNR Ranges



The intervention types for the bridges listed in Table 5-1 have been determined as shown in Table 5-3 and Table 5-4 for major maintenance and network development respectively.

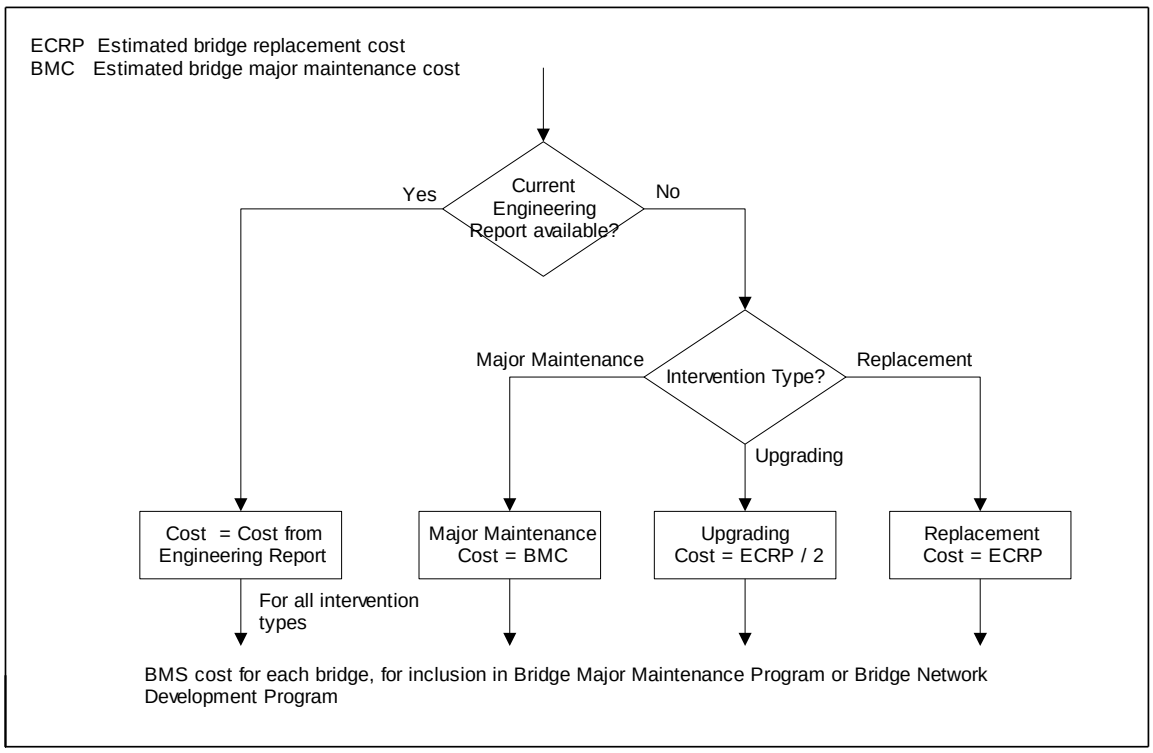
Determine the cost of the intervention required to each bridge

The cost of the recommended intervention will be determined as shown in Figure 5-4.

If a current Engineering Inspection Report is available, the estimated costs given in the report are adopted as these are based on a detailed investigation of the reported bridge defects.

Otherwise, the cost of the intervention is estimated using the estimated bridge repair cost determined during the Annual Condition Survey or from the estimated bridge replacement cost based on the deck area of the bridge.

Figure 5-4
Determination of cost of Intervention



Determine the priority score for each bridge

Separate Major Maintenance and Network Development programs are developed as these have two distinctly different funding processes.

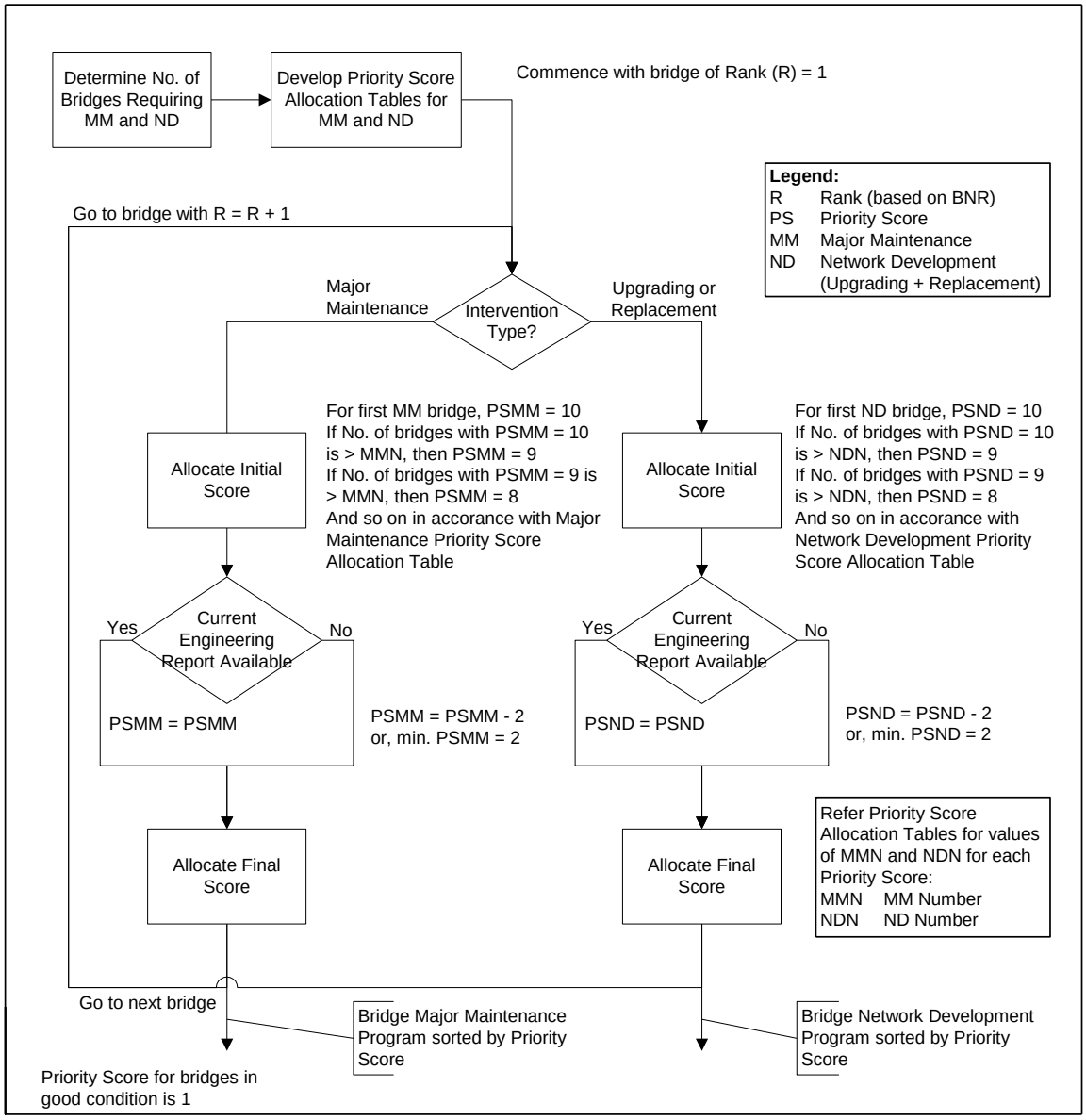
Determine the number of bridges to be included in each program. For example, the number of bridges in each program for the bridges included in Table 5-1 are as follows:

- Major Maintenance 93 bridges
- Network Development 13 bridges
- Good condition 44 bridges

Develop the appropriate scoring allocation tables to suit the number of bridges in each program.

For example, the scoring tables included in Table 5-2 were developed to suit the bridges included in Table 5-1.

Figure 5-5
Allocation of Priority Score



The priority score for each bridge, in both the Major Maintenance and Network Development programs, is determined as shown in Figure 5-5.

The allocation is based on the scoring allocation tables, which set the number of bridges included in each priority score zone.

Scoring allocation tables will be developed annually, when the number of bridges to be included in each program has been determined. The scoring tables are determined to include all bridges in each program in nine scoring zones from 2 to 10 with bridges in Zone 10 having the highest priority for intervention. All bridges in good condition and not requiring intervention are included in Zone 1 but are not separately listed.

The score allocation tables are designed such that there are a smaller number of bridges in the higher scoring zones.

The bridges are scored based on ranking determined from the calculated BNR values. The bridge with the highest calculated BNR has the highest priority of 1 and so on.

The scoring system favors those bridges where a current Engineering Inspection Report is available as those bridges without a current Engineering Inspection Report have their priority decreased by two zones.

Bridges nominated for upgrading or replacement based on other criteria (e.g. overloading), but otherwise in good condition, have no calculated BNR or rank and are not ranked. These bridges are listed after the ranked bridges in the Network Development Program.

Table 5-2
Trial Scoring Allocation Tables

Priority Score	No. of Bridges in Zone	
	ND	MM
10	2	5
9	2	5
8	2	10
7	2	10
6	2	10
5	2	10
4	2	10
3	2	17
2	Balance	balance
1	-	-

The allocated scores for the bridges from Table 5-1 included in a Major Maintenance Program are listed in Table 5-3.

The allocated scores for the bridges from Table 5-1 included in a Network Development Program are listed in Table 5-4.

Table 5-3
Trial Major Maintenance Program

Bridge ID	Code	Rank	RER	ERR	EC	MMP
B00082LZ	NGR	19	MAJOR	MAJOR	260,000.00	10
B00083LZ	SGR	28	MAJOR	MAJOR	125,000.00	10
B00060LZ	CGR	30	MAJOR	MAJOR	235,000.00	10
B00107LZ	CGR	39	MAJOR	MAJOR	180,000.00	10
B00029LZ	SGR	47	MAJOR	MAJOR	450,000.00	10
B00110LZ	CGR	58	MAJOR	MAJOR	230,000.00	9
B00115LZ	CGR	78	MAJOR	MAJOR	260,000.00	9
B00055LZ	CGR	112	ROUTINE	MAJOR	770,000.00	9
B00087LZ	SGR	12	MAJOR		470,000.00	8
B00047LZ	CGR	13	MAJOR		195,000.00	8
B00096LZ	SGR	14	MAJOR		130,000.00	8
B00149LZ	STR	15	MAJOR		195,000.00	8
B00011LZ	CGR	16	MAJOR		470,000.00	8
B00043LZ	CGR	17	MAJOR		90,000.00	8
B00009LZ	CGR	18	MAJOR		71,000.00	8
B00144LZ	SOS	20	MAJOR		450,000.00	8
B00052LZ	CGR	21	MAJOR		250,000.00	8
B00125LZ	CGR	22	MAJOR		20,000.00	8
B00028LZ	CSL	23	MAJOR		35,000.00	7
B00108LZ	CGR	24	MAJOR		48,000.00	7
B00139LZ	CGR	26	MAJOR		185,000.00	7
B00091LZ	CGR	27	MAJOR		200,000.00	7
B00056LZ	CGR	29	MAJOR		40,000.00	7
B00084LZ	CGR	31	MAJOR		85,000.00	7
B00021LZ	CSL	32	MAJOR		75,000.00	7
B00126LZ	CGR	33	MAJOR		72,000.00	7
B00081LZ	CGR	34	MAJOR		36,000.00	7
B00145LZ	SBY	35	MAJOR		290,000.00	7
B00121LZ	CTR	36	MAJOR		240,000.00	6
B00062LZ	CGR	37	MAJOR		175,000.00	6
B00137LZ	CGR	38	MAJOR		178,000.00	6
B00026LZ	STR	40	MAJOR		300,000.00	6
B00073LZ	CGR	41	MAJOR		480,000.00	6
B00142LZ	CGR	42	MAJOR		130,000.00	6
B00048LZ	CGR	43	MAJOR		19,000.00	6
B00128LZ	CGR	44	MAJOR		120,000.00	6
B00147LZ	CAR	45	MAJOR		90,000.00	6
B00097LZ	CGR	46	MAJOR		80,000.00	6

B00148LZ	CGR	48	MAJOR		5,160,000.00	5
B00093LZ	CGR	49	MAJOR		160,000.00	5
B00054LZ	CGR	50	MAJOR		30,000.00	5
B00012LZ	CGR	51	MAJOR		126,000.00	5
B00002LZ	CGR	52	MAJOR		290,000.00	5
B00135LZ	CGR	53	MAJOR		1,050,000.00	5
B00152LZ	CGR	54	MAJOR		160,000.00	5
B00141LZ	CGR	55	MAJOR		260,000.00	5
B00034LZ	CGR	56	MAJOR		415,000.00	5
B00117LZ	STR	57	MAJOR		0.00	5
B00122LZ	CGR	59	MAJOR		50,000.00	4
B00103LZ	CAR	60	MAJOR		198,000.00	4
B00086LZ	SGR	61	MAJOR		206,000.00	4
B00092LZ	CGR	62	MAJOR		50,000.00	4
B00008LZ	CGR	63	MAJOR		371,000.00	4
B00077LZ	CGR	64	MAJOR		40,000.00	4
B00001LZ	CGR	65	MAJOR		68,000.00	4
B00106LZ	SGR	66	MAJOR		220,000.00	4
B00150LZ	CGR	67	MAJOR		0.00	4
B00039LZ	CAR	68	MAJOR		16,000.00	4
B00033LZ	CGR	69	MAJOR		328,000.00	3
B00071LZ	SGR	70	MAJOR		135,000.00	3
B00004LZ	CGR	71	MAJOR		72,000.00	3
B00116LZ	CGR	72	MAJOR		147,500.00	3
B00005LZ	SGR	73	MAJOR		1,774,000.00	3
B00113LZ	CGR	74	MAJOR		109,000.00	3
B00112LZ	CGR	75	MAJOR		125,000.00	3
B00080LZ	CGR	76	MAJOR		84,000.00	3
B00053LZ	SGR	77	MAJOR		42,000.00	3
B00101LZ	CGR	79	MAJOR		205,000.00	3
B00068LZ	CGR	80	MAJOR		23,000.00	3
B00051LZ	SGR	81	MAJOR		17,000.00	3
B00006LZ	CGR	82	MAJOR		271,000.00	3
B00130LZ	CSL	83	MAJOR		270,000.00	3
B00131LZ	CSL	84	MAJOR		270,000.00	3
B00102LZ	SCS	85	MAJOR		400,000.00	2
B00042LZ	CGR	86	MAJOR		75,000.00	2
B00105LZ	CGR	87	MAJOR		80,000.00	2
B00088LZ	CGR	88	MAJOR		70,000.00	2
B00018LZ	CGR	89	MAJOR		40,000.00	2
B00069LZ	SGR	90	MAJOR		260,000.00	2
B00010LZ	SGR	91	MAJOR		160,000.00	2
B00003LZ	STR	95	MAJOR		23,000.00	2
B00025LZ	CAR	96	MAJOR		27,000.00	2
B00074LZ	CGR	97	MAJOR		80,000.00	2

B00095LZ	CAR	98	MAJOR		54,000.00	2
B00046LZ	CGR	99	MAJOR		12,000.00	2
B00133LZ	CGR	103	MAJOR		210,000.00	2
B00119LZ	CGR	104	MAJOR		100,000.00	2
B00063LZ	CGR	105	MAJOR		5,000.00	2
B00031LZ	CGR	106	MAJOR		532,000.00	2
B00030LZ	MAR	107	MAJOR		18,000.00	2
B00020LZ	CGR	108	MAJOR		40,000.00	2
B00124LZ	CGR	110	MAJOR		30,000.00	2
B00024LZ	CGR	111	MAJOR		56,000.00	2
					22,743,500.00	

RER Revised recommendation of condition inspection
ERR Engineering inspection recommendation
EC Estimated cost of major maintenance
MMP Major Maintenance priority score.

Table 5-4
Trial Network Development Program

Bridge ID	Rank	RER	ERR	EC	Reason	NPV/C	NDP
B00118LZ	4	REPLACE	REPLACE	3,600,000.00	DETERIORATION	1.56	10
B00123LZ	5	UPGRADE	UPGRADE	1,080,000.00	DETERIORATION		10
B00079LZ	6	REPLACE	REPLACE	8,800,000.00	DETERIORATION		9
B00019LZ	1	REPLACE		50,550,000.00	DETERIORATION		8
B00090LZ	2	REPLACE		29,892,000.00	DETERIORATION		8
B00134LZ	3	UPGRADE		2,875,500.00	DETERIORATION		7
B00037LZ	7	UPGRADE		975,000.00	DETERIORATION		7
B00094LZ	8	UPGRADE		4,792,500.00	DETERIORATION		6
B00013LZ	9	UPGRADE		71,760,500.00	DETERIORATION		6
B00058LZ	10	UPGRADE		11,316,000.00	DETERIORATION		5
B00136LZ	11	UPGRADE		23,875,000.00	DETERIORATION		5
B00114LZ	25	UPGRADE		4,680,000.00	DETERIORATION		4
B00089LZ	135	ROUTINE	REPLACE	10,000,000.00	OVERLOADING	1.20	4
				224,196,500.00			

RER Revised recommendation of condition inspection
ERR Engineering inspection recommendation
EC Estimated cost of replacement or upgrading project
NPV/C Net present value divided by implementation cost
NDP Network development priority score

Prepare BMS Reports

The updated BMS with the intervention type, intervention cost and priority score calculated for each bridge, is available to provide the full range of BMS reports required by the DPWH.

The standard reports are listed in Table 5-5.

Table 5-5
BMS Program Reports

Report ID	Graph ID	Report Name
Bridge Major Maintenance Program		
BRMM_01	-	Major Maintenance Program, Country Summary
BRMM_02	-	Major Maintenance Program, Region Summary
BRMM_03	-	Major Maintenance Program, Engineering District Summary
BRMM_04	-	Major Maintenance Program by Priority Score
Bridge Network Development Program		
BRND_01	-	Network Development Program, Country Summary
BRND_02	-	Network Development Program, Region Summary
BRND_03	-	Network Development Program, Engineering District Summary
BRND_04	-	Network Development Program by Priority Score
Bridge Combined Programs		
-	BGCP_02	Overall Bridge Management Program
BCP_03	-	Bridge Status Report

Typical BMS Program Reports are presented in Figure 5-6.

A graphical report of the overall bridge management program based on data extracted from the BMS is shown in Figure 5-7.

The BMS will provide reports on any of the bridge data held within the RBIA and BMS, in any desired format. Other report templates can be prepared as required for this purpose.

Figure 5-6
Typical BMS Program Reports

Department of Public Works and Highways

BRIDGE MAJOR MAINTENANCE PROGRAM
REGION SUMMARY

FISCAL YEAR: <insert budget year>
REGION: <insert region>

ENGINEERING DISTRICT	BRIDGES IN ENGINEERING DISTRICT	PROPOSED MAJOR MAINTENANCE PROJECTS	
	NUMBER	NUMBER	ESTIMATED COSTS (Million Pesos)
TOTAL			

DATE OF ISSUE: <insert date of printing from BMS>

Report BRMM_02

Department of Public Works and Highways

BRIDGE NETWORK DEVELOPMENT PROGRAM
COUNTRY SUMMARY

FISCAL YEAR: <insert budget year>

REGION	EXISTING BRIDGES IN REGION	PROPOSED UPGRADING OR REPLACEMENT PROJECTS	
	NUMBER	NUMBER	ESTIMATED COSTS (Million Pesos)
I			
II			
CAR			
III			
NCR			
IV-A			
IV-B			
V			
VI			
VII			
VIII			
IX			
X			
XI			
XII			
XIII			
ARMM			
TOTAL			

DATE OF ISSUE: <insert date of printing from BMS>

Report BRND_01

Department of Public Works and Highways

BRIDGE NETWORK DEVELOPMENT PROGRAM
ENGINEERING DISTRICT SUMMARY

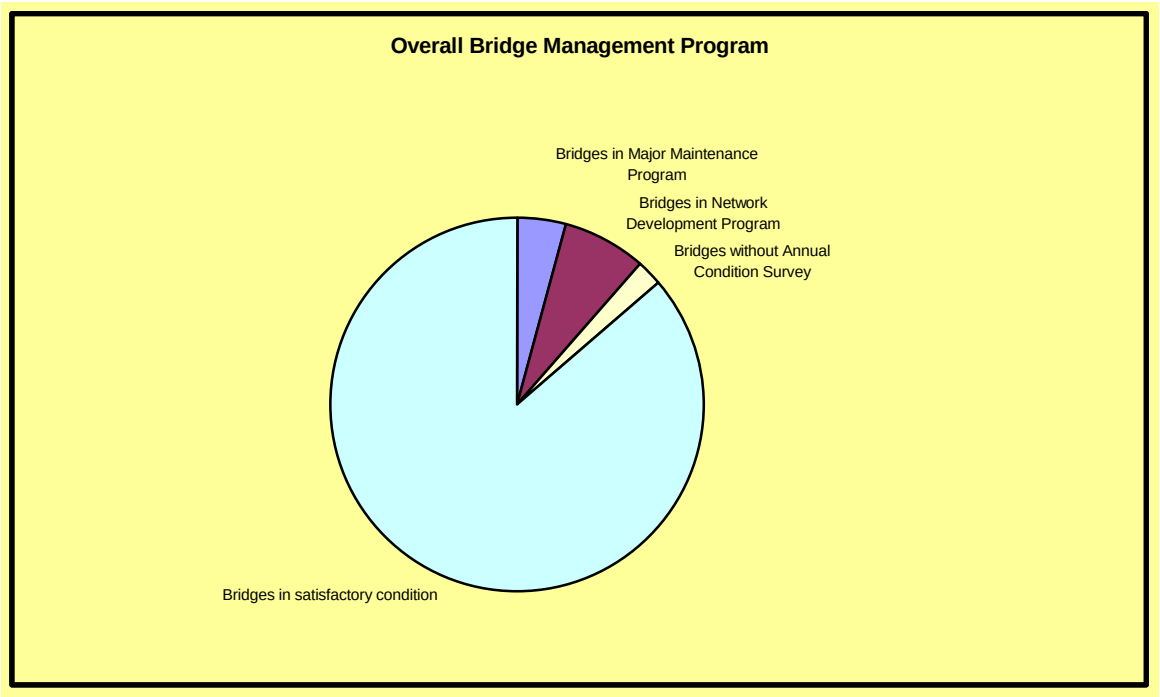
FISCAL YEAR: <insert budget year>
REGION: <insert region>
ENGINEERING DISTRICT: <insert engineering district>

ROAD DETAILS			BRIDGE DETAILS		LOCATION	BRIDGE CODE	UPGRADE(U), REPLACE (R) OR NEW (N)	ESTIMATED COST (Million Pesos)	NPV / C	PRIORITY SCORE	REASON FOR INCLUSION
ROAD ID	SECTION ID	NAME	BRIDGE ID	NAME							

DATE OF ISSUE: <insert date of printing from BMS>

Report BRND_03

Figure 5-7
Overall Bridge Management Program



APPENDIX A
LIST OF BMS PROCEDURES

Procedure No.	Procedure Title	Version No.	Effective Date
A121	Schedule Bridge Condition Survey	3.0	January 15, 2004
A122	Train/Update Bridge Inspectors	3.0	January 15, 2004
A123	Prepare Bridge Condition Reports	3.0	January 15, 2004
A21	Review Condition Data	3.0	January 15, 2004
A22	BNR Analysis and Ranking	3.0	January 15, 2004
A24	Assess Routine Maintenance Requirements	3.0	January 15, 2004
A3	Engineering Inspections	3.0	January 15, 2004
A4	BMS Reporting	3.0	January 15, 2004