BEST PRACTICE MANUAL

Visitor Monitoring System for the Wet Tropics World Heritage Area

Volume 1
Procedural Manual

R. F. Wilson, S. M. Turton,
J. M. Bentrupperbäumer and J. P. Reser

Rainforest CRC

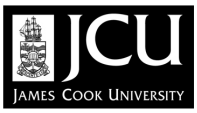
Cooperative Research Centre for Tropical Rainforest Ecology and Management

VISITOR MONITORING SYSTEM FOR THE WET TROPICS WORLD HERITAGE AREA

VOLUME 1
Procedural Manual

R. F. Wilson[1], S. M. Turton[1],
J. M. Bentrupperbäumer[1] and J. P. Reser[2]

[1]School of Tropical Environment Studies and Geography, James Cook University
[2]School of Psychology, James Cook University



Rainforest CRC

Established and supported under the
Australian Cooperative Research Centres Program

ISBN 0 86443 741 2
(Set of Volumes 1, 2 and 3)

0 86443 742 0
(Volume 1)

Published by the Cooperative Research Centre for Tropical Rainforest Ecology and Management. Further copies may be requested from the Cooperative Research Centre for Tropical Rainforest Ecology and Management, James Cook University, PO Box 6811 Cairns, QLD, Australia 4870.

This publication should be cited as: Wilson, R. F., Turton, S. M., Bentrupperbäumer, J. M. and Reser, J. P. (2004) *Visitor Monitoring System for the Wet Tropics World Heritage Area: Volume 1 Procedural Manual.* Cooperative Research Centre for Tropical Rainforest Ecology and Management. Rainforest CRC, Cairns. (96pp.)

Cover Images:
J. M. Bentrupperbäumer

December 2004

For copies of this document, please visit: www.rainforest-crc.jcu.edu.au

PREFACE

Almost three million visitors cannot be wrong! The Wet Tropics World Heritage Area of North Queensland is not only a precious ecological asset, it has also become one of Australia's most outstanding attractions for local, interstate and international visitors. Queensland's reputation and status as a tourism destination owes much to its natural environment, not least the wonders of our tropical forests and landscapes.

Tourism in the World Heritage Area alone is estimated to generate over A$750 million (Driml 1997) of economic benefit for local communities each year. The Wet Tropics region has experienced significant increases in domestic and international tourism over the past twenty years, with some two million visitors per year in 1995 and an estimated three million in 2003. Recent projections suggest that tourist numbers will reach four million per year by 2016, with an increase in international visitors being a major contributing factor.

The recent *Wet Tropics Visitor Survey* (Bentrupperbäumer and Reser, 2002) has estimated about 4.4 million visits per year to recognised Wet Tropics World Heritage Area sites, with sixty percent of these visits by domestic and international tourists. The remaining forty percent were local residents engaging in rainforest-based recreational activities. In addition, it is estimated that some 270,000 people will live in the Wet Tropics region by 2016, placing increasing pressure on the World Heritage Area.

The *Wet Tropics Nature Based Tourism Strategy* (Wet Tropics Management Authority 2000) and *Wet Tropics Walking Strategy* (Wet Tropics Management Authority 2000) both address tourism and recreation issues in the World Heritage Area, and both have identified the need to develop a Visitor Monitoring System for ongoing evaluation of the environmental condition of some 180 recognised visitor nodes and sites in the area. Successful strategies to address these needs requires sound scientific advice on environmental impacts of visitation and use on the World Heritage Area. Only on this basis can effective management tools and practices be implemented to achieve sustainable outcomes.

The initial proposal for the Visitor Monitoring System was discussed with the Rainforest CRC's Program 4 Support Group in 2001, the role of which is to ensure that researchers and research users collaborate at every stage of the project. With strong endorsement from the Support Group, the Visitor Monitoring System has been designed to provide advice to managers of the Wet Tropics World Heritage Area on the basis of a hierarchical monitoring system that engages tour operators, park rangers and researchers. Once operational, the Visitor Monitoring System will allow environmental agencies to base land-management decisions on sound scientific advice – a crucial requirement that has been identified by industry, conservation groups and management agencies.

While specifically designed for the Wet Tropics World Heritage Area, this 'gold-standard' three-volume best practice manual is sufficiently generic to be of considerable value to protected area managers in other parts of Australia and overseas.

Tourism, research and conservation have a strong mutual interest. The Rainforest CRC has a long-term commitment to tourism research in tropical Australia, and the tourism industry has long been a major user of its research and a driver of the CRC's research agenda for the last ten years.

I congratulate the Rainforest CRC, the authors and the production team for the practical and highly valuable contribution they have made to sustainable tourism and conservation. I recommend the Visitor Monitoring System tools to all stakeholders in industry and in government agencies, and look forward to a continued tourism industry partnership with all stakeholders of the Wet Tropics World Heritage Area.

Daniel Gschwind
Chief Executive Officer
Queensland Tourism Industry Council

TERMS OF REFERENCE

DEVELOPMENT OF A VISITOR MONITORING SYSTEM FOR THE WET TROPICS WORLD HERITAGE AREA

The following Terms of Reference are quoted directly from the Wet Tropics Management Authority Contract (No. 658).

Purpose of the Contract

The *Wet Tropics Nature Based Tourism Strategy* (NBTS) and *Wet Tropics Walking Track Strategy* (WS) identify the need for a visitor monitoring system (VMS) associated with nature based tourism and recreation activities in the Wet Tropics World Heritage Area (WTWHA) and surrounding areas.

The proposed VMS aims to build on past and current research and monitoring of visitor management, coordinating the work of various researchers and land managers to provide a comprehensive and practical system for monitoring all aspects of visitor management. The project provides a necessary link between the research goals of Rainforest CRC Programs 3 and 4, which are essentially concerned with rainforest visitation and usage at regional and local level, respectively.

Aims of the Project

The aim of this project, essentially, is to design a robust, efficient, practical and cost-effective VMS for the WTWHA and environs, which assists management in identifying whether visitor management objectives are being met so that appropriate management responses can be made.

Key Attributes Required of the VMS Design

The VMS must be efficient, practical and cost-effective to implement.

The design should be recognised by both tourism interests and protected area managers as a robust, useful and worthwhile system for tourism and visitor management information and as a support for decision-making.

The site-monitoring component, which requires ongoing monitoring by field staff and/or tour operators, should be able to be readily incorporated into regular visitor management and tour operations. The benefits of conducting such monitoring must be readily demonstrable to field staff.

The VMS can be applied across the range of visitor site scenarios occurring in the study area (N.B. site monitoring elements are to be demonstrated at four pilot sites as part of this project).

The VMS design will also incorporate:

- Monitoring at other key regional locations (e.g. information centres, airports);
- Survey components and associated questionnaires to complement ongoing monitoring systems. (N.B. As part of a separate but complementary project, the Rainforest CRC will be designing and undertaking site visitor surveys to plug into this VMS. However, this VMS project will need to design more intensive and targeted survey components for the

four pilot sites, and ensure such surveys are completed as part of the 2001/2002 survey project);

- Elements associated with monitoring pre-destination marketing, promotions and trip planning information;
- Elements associated with monitoring suitability and appropriateness of information accessible to visitors on arrival to the Wet Tropics region, to assist in 'matching' visitor interests and expectations with available nature based tourism products; and
- A trends-based approach, which will assist management in identifying whether visitor management objectives are being met so that appropriate management responses can be made.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

Many people made contributions to the development and completion of this project.

We would especially like to acknowledge the Wet Tropics Management Authority (WTMA), Tourism Queensland (TQ) and Department of Natural Resources and Mines (NR&M) for their financial contributions (WTMA $87,700; TQ $20,000; and NR&M $5,000). The Adventure Company provided transport for the tourist industry field trip.

We are especially grateful to Mr Max Chappell and Mr Campbell Clarke of WTMA for their collaboration, advice, support and enthusiasm throughout this project.

We are also grateful to members of the tourism industry who participated in our field trips and trial of our proformas (names are withheld due to confidentiality). In particular, we acknowledge Mr John Courtenay for organising buses for field trips and arranging time for us to speak at the Tourism Alliance Meetings, and Mr Gordon Dixon for inviting us to speak at the Tourism Executives Meeting, and encouraging tour operators to participate in the trial of our proformas.

Thanks to:

- Mr Andrew Spooner, Mr Jeremy Small, Mr Bill Dorries and Mr Richie Carrigan of Queensland Parks and Wildlife Service for meeting us on site and discussing issues related to visitation on their parks;
- Mr Tim Wood for demonstrating the use of the NR&M outdoor recreational assessment process and providing information on the process;
- Ms Jennifer Butler for providing maps of Davies Creek and Murray Falls;
- The Rainforest CRC and School of Tropical Environmental Studies and Geography (TESAG), James Cook University, for providing infrastructure and academic and administrative assistance where required;
- Dr Ian Curtis for conducting a review of visitor monitoring systems used elsewhere in Australia (see Table 1, this volume); and
- Mr Lucas Talbot for assisting in data entry.

EXECUTIVE SUMMARY

RESEARCH OBJECTIVES

1. To identify and collate existing expertise and data to develop a framework for a visitor monitoring system (VMS) for the Wet Tropics region that is recognised by tourism and protected area management.
2. To design a robust, efficient, practical and cost-effective system that incorporates both site and regional level components and to trial the system in the field.

INTRODUCTION

Australia's Wet Tropics World Heritage Area (WTWHA) is of international significance. It is the duty of the Australian community to ensure its special values are protected, conserved, presented and rehabilitated for future generations (WTMA 2000). In order to meet these obligations it has been recognised that the WTWHA requires a visitor monitoring system that incorporates regional and site level monitoring and involves all levels of users, commercial and free and independent travellers, and managers (WTMA 2000, 2001).

The Wet Tropics are an internationally acclaimed visitor destination (WTMA 2000). In 1998, there were over two hundred commercial tour operators with permits to operate within the Wet Tropics (QPWS 1998), most of who were operating in far north Queensland within the WTWHA (TQ 1998). Visitors to the WTWHA sites also include domestic travellers and the local community. A survey, conducted in 1998 by Tourism Queensland, found domestic travellers account for more than eighty percent of visitors to Queensland (TQ 1998). Direct use of the WTWHA by tourists is estimated to generate over $179 million annually, which is a significant economic contribution to the local and regional economy (Driml 1997).

There are over 180 sites being used by visitors to the WTWHA, of which 94 have associated infrastructure (WTESSC 1996). This is a significant number of sites. Visitation is increasing to WTWHA sites and this requires careful management if it is to be sustainable. Human presence in any natural environment results in some level of disturbance (Hammitt and Cole 1998) and these impacts require monitoring.

Tour operators have reported that in the past their observations and comments to management regarding negative impacts associated with visitation were not always addressed. This highlights the need for a formalised monitoring system that ensures their concerns are recorded and, if necessary, acted upon. Therefore the first level of monitoring in the visitor monitoring system produced for the Wet Tropics Management Authority involves the tourism industry.

Sites with low levels of visitation are primarily visited by the local community and the more adventurous independent travellers. The types of impacts occurring at these sites are different than those at high use areas. Tour groups do not usually visit low use sites and thus land managers form the first level of monitoring at these sites.

Visitation and use of sites changes over time, so site managers require a monitoring system that will track these changes and respond as necessary.

There are three basic levels to the visitor monitoring system presented in this report: 1) tour operator rapid assessment; 2) land manager semi-rapid assessment; and 3) researcher semi-intensive assessment.

STRUCTURE OF THE VISITOR MONITORING SYSTEM BEST PRACTICE MANUAL

The Best Practice Manual consists of four sections, separated into three Volumes:

- Volume 1: Procedural Manual;
- Volume 2: Visitor Monitoring Process – From Pre-Destination to Post-Destination; and
- Volume 3: Case Studies – Biophysical Assessment.

Section 1 (Volume 1) details how the components of the VMS link to provide useful information for visitor management. It also shows how this VMS links with other VMS at a national, state and regional level and how it is complemented by other research and survey activities within the Rainforest CRC.

Section 2 (Volume 1) presents the protocols, proformas and methods used to monitor visitation and use, and directions for how the VMS might be enhanced with additional data from other sources in the future.

Section 3 (Volume 2) details how the VMS may be linked with pre- and post-destination planning and other components of the travel sequence.

Section 4 (Volume 3) comprises four case studies used to develop and trial the visitor monitoring system.

OVERVIEW OF SECTION 1: STRATEGIC LINKAGES (THIS VOLUME)

In this section, we report on visitor monitoring conducted at a national, state and regional level. We discuss the work undertaken in Project 4.1 of the Rainforest CRC, which involved site and regional monitoring, and its links to Project 4.5 and pre-destination planning. Within Project 4.1 two types of surveys were conducted. The first was conducted during the wet and dry season at ten sites distributed throughout the Wet Tropics World Heritage Area (WTWHA); the second was a community attitudes survey. The site level work of Project 4.1 was developed further at four sites to provide a linkage to Project 4.5 (which addresses the biophysical impacts of visitation) by including an additional section in the visitor survey that addressed visitors' perceptions of biophysical impacts. Regional level monitoring conducted at gateways (Project 3.1, Rainforest CRC) to provide a link between site and regional level monitoring, was not completed. A genuine attempt to link site level monitoring and regional monitoring was undertaken by Project 4.1 by aggregating data collected at the ten survey sites.

Key Findings

There are few examples of visitor monitoring systems in Australia. Most visitor monitoring systems are being developed for protected areas by national park agencies. They range in complexity from general regional surveys of visitation and traffic counts to more detailed systems that include visitor surveys of peoples' experiences, expectations and satisfaction, and actual biophysical monitoring. However, they do not attempt to link components of visitor monitoring at a regional and site level.

To a large extent, existing systems and methods are serving very different objectives and addressing very different target populations and client/consumer audiences, as well as operating at different levels of analysis and spatial scales.

Our VMS has a more balanced approach compared with others we have reviewed, as it includes not only biophysical impacts of visitation and use but also the impact of settings and experiences on visitors. Moreover, our system attempts to correct any adverse trends impacting on visitors and the environment.

Recommendations

Regional components of the VMS should include visitor pre-destination planning, arrival and departure information and community attitudes. A strategic framework is presented, examining how the VMS relates to other components of the travel sequence. We recommend the adoption of the visitor monitoring techniques developed for the various travel stages, although we acknowledge that further research will be required to operationalise these methods.

Site level components should include traffic counts, which are verified by on-site observations of vehicle occupancy, visitor surveys, observations of visitor behaviour on-site, and biophysical impact monitoring. These components should be supplemented by qualitative information from tour operators, land managers and the Aboriginal community that together provide the data to trigger responses by management.

Management Implications

With respect to a fully operational and satisfactory VMS, it is likely that two or more independent 'systems' will be adopted and implemented. The first will focus on site level and resident community management, and reporting needs relating to changes and impacts resulting from all human visitation and use. A second tourism planning and industry sponsored system will have a clearer focus on the monitoring of visitation patterns and profiles, destinations and decisions for those tourists visiting the WTWHA bioregion, and more generally, far north Queensland.

The more 'regional' tourism planning and industry sponsored system will in any case need to articulate with other state-wide and national tourism monitoring enterprises. It will serve rather different needs and requirements, though their findings are nonetheless of particular interest and relevance to protected area management, especially with respect to the assessment and quantification of changing 'pressures' and preferences, and both visitor satisfaction and tourism-related economic benefit.

Further Research

The relationship between the VMS and the full travel sequence has only been considered in general terms in this report. Recommendations are given on how different stages of travel might be monitored. A more detailed analysis of these recommendations is an area for further study.

OVERVIEW OF SECTION 2: PROCEDURES AND PROFORMAS FOR MONITORING BIOPHYSICAL IMPACTS OF VISITATION (THIS VOLUME)

Section 2 of the report details the procedures and proformas for conducting a biophysical monitoring program at a site level in the WTWHA. Biophysical impacts in this context refer to impacts on the natural environment and visitor infrastructure. The methods and indicators chosen for this VMS allow basic visitor monitoring and use simple, robust, and cost-effective measures. This VMS was designed to identify positive, neutral and negative trends in the environment, infrastructure and services at a site. If negative trends were identified, then the

action to be implemented will depend on the nature, severity and source of impact, management intent and current management practices in place.

Procedures and proformas were designed for a tropical rainforest setting but may be applied to other natural settings. Types of monitoring are presented in order of increasing complexity, that is, from rapid assessment to detailed field-based measurements. We consider how the site monitoring components should be set up, and how the survey components should be applied.

Visitors to sites, whether on tours or as independent travellers, impact on the natural environment and have the potential to affect the quality of a site. The condition of the site also impacts on the visitor. Monitoring allows early detection of potential problems and thus assists in the preservation of a site and allows management to identify whether or not their objectives are being met.

Indicators included in the proformas were identified and collated from research and consultation with members of the tourist industry and protected area managers. Indicators used by researchers were adapted from methods used overseas and within Australia.

Key Findings

Tour operators represent the first level of visitor monitoring and are very important in the VMS for alerting land managers to problems, triggering immediate action and, if necessary, further intensive monitoring. We recognise that tour operators make more frequent visits than land managers to most sites and are in the position to give an early warning of any adverse impacts.

It is recognised that there are site-specific issues, which will be addressed for each site. Of the four VMS sites, only Marrdja Boardwalk is being used on a regular basis by tour groups. Particular issues at this site include the use of bus parking spaces by free and independent travellers and unauthorised tour groups, and visitors walking the wrong way around the boardwalk.

Protected area managers (rangers) represent the second level of visitor monitoring. The techniques employed are more intensive and comprehensive than those used by tour operators and so can be conducted less often. Specifically, we have developed and tested proformas for campsites and picnic sites, walking tracks and water features.

Recommendations

It is recommended that all tour guides conduct their VMS survey component once a week and incorporate it into their tour. This will allow a temporal overview of the site in a day. Benefits for tour guides include:

- involvement in management practices;
- opportunities to involve visitors in monitoring; and
- increased awareness of the environment by operators and their guests.

Monitoring techniques developed for rangers should be undertaken four times a year. Those developed for researchers should be conducted at least bi-annually.

Management Implications

The tour operator proforma was designed to:

- assist in monitoring site changes over time;
- increase awareness of changes in the environment;
- assist rangers in identifying problems;
- provide information to trigger land management actions; and
- provide an early warning to trigger intensive survey work.

Ranger-level proformas inform management on a range of human and environmental risks, including:

- inappropriate visitor behaviour;
- the need for greater ranger presence;
- the status of maintenance of infrastructure;
- the need for signs or fenced-off areas;
- information about visitor movements;
- tracking of maintenance needs;
- waste disposal problems;
- potential for human risk;
- disturbance to flora and fauna due to visitation;
- soil erosion; and
- decline in health of vegetation.

Further Research

Site-level survey instruments will be applied and tested at further visitor sites in the Wet Tropics to evaluate their utility across a range of settings.

OVERVIEW OF SECTION 3: VISITOR MONITORING PROCESS – FROM PRE-DESTINATION TO POST-DESTINATION (VOLUME 2)

Section 3 is presented in three sections:

- The visitation process;
- Methodologies used to monitor the visitation process; and
- An example illustrating the process.

The four stages of the visitation process under consideration include: planning the visit, access to the site; the onsite visit; and finally, the post site visit. The methodologies used to research the different stages of the visitation process are outlined and are those that have been used in the research reviewed (e.g. content analysis, surveys, impact assessments, infrastructure inventories etc.). The example provided illustrates how monitoring a particular issue, i.e. information flow, can be examined across each of the stages of the visitation process (e.g. brochures, signage etc.).

Marrdja Boardwalk, a key WTWHA site, is examined as a case study. The case study systematically addresses and presents research results for each component of the visitation process and current management policies. These together provide for an articulation of the management objectives and possible responses/actions.

Finally, a summary overview of the Marrdja case study is presented. This section identifies those aspects of the visitation process and VMS that need further research.

OVERVIEW OF SECTION 4: CASE STUDIES – BIOPHYSICAL ASSESSMENT (VOLUME 3)

Case studies, including data for Marrdja Boardwalk, Davies Creek, Henrietta Creek/Nandroya Falls and Murray Falls are contained in Volume 3.

Key Findings

A hierarchical system of monitoring visitation and use of Wet Tropics sites is feasible and operational but depends on the commitment of tour operators, land managers and researchers to make it successful.

A rapid assessment proforma developed for tour operator site monitoring allows for early detection of potential problems.

Intensive biophysical monitoring undertaken by researchers indicated high variability within sites, which negated the opportunity to compare amongst sites.

Common issues across sites included weed infestations along roads, walking tracks, camp and picnic areas, and evidence of feral pigs.

Intensive biophysical monitoring indicated people were keeping to walking tracks and not venturing into the forest, except where social (undesignated) tracks had developed. When this occurred, activity was confined to undesignated tracks and not widespread within the forest.

Human litter was an issue in habitats bordering camp and picnic areas.

A comparison of human perceptions of biophysical impacts and measured biophysical impacts using Land Manager Proformas indicated:

- water quality was the only indicator where reasonable agreement between peoples' perceptions and biophysical assessments occurred;
- biophysical measures suggested infrastructure damage was higher than that perceived by visitors;
- weeds and evidence of feral animals were more likely to be higher than visitor perceptions suggested;
- no clear correlation between perceptions and biophysical assessment were evident for soil erosion, vegetation damage or scavenging; and
- visitor responses were not providing appropriate information for managers.

Recommendations

- Develop a database that allows tour operators and land managers to enter data and receive an update on the condition of their sites.

- Hold workshops for tour operators and land managers on use of the proformas.
- Trial the Land Manager Proformas with rangers.
- Implement the Visitor Monitoring System.
- Take water samples for laboratory testing from sites used by visitors during intermediate assessments by land managers.

Management Implications

Social (undesignated) tracks pose potential human risk, as they may occur on steep sections of tracks or near waterholes and waterfalls. They may also cause environmental impacts such as erosion, and act as vectors for the spread of pathogens. Social tracks may also intrude on sensitive Aboriginal sites.

Weeds were dense along the edge of camp and picnic areas and water bodies, and need to be controlled to prevent further distribution.

Human litter within forest bordering camp and picnic areas needs attention, as poses a risk to wildlife and humans.

Future Research

Develop a weighting system, as attempted in this project with the modified Land Manager Proformas, that allows a condition score for natural and built environments to determine any human risk.

Identify potential indicators of visitation and wildlife interactions.

SECTION 1: STRATEGIC LINKAGES

SECTION 1: STRATEGIC LINKAGES

INTRODUCTION

Australia's Wet Tropics World Heritage Area (WTWHA) is of international significance. It is the duty of management agencies to ensure its special values are protected, conserved, presented and rehabilitated for future generations (WTMA 2000). Human presence in any natural environment results in some level of disturbance, for example, walking in a non-hardened environment results in environmental changes in soil compaction, vegetation, hydrology and the potential to disturb wildlife (Hammitt and Cole 1998; Talbot *et al.* 2003). Even low levels of visitation can cause significant impacts on the environment. Visitation in the WTWHA is increasing, requiring careful management if it is to be sustainable. In order to recognise and respond to environmental change in the WTWHA, a visitor monitoring system is required (WTMA 2000, 2001).

There are *ca.* 180 visitor sites that are regularly used within the WTWHA (WTMA 2000). This is a significant number of sites, although the area reserved for visitation is concentrated and relatively small. However, the impacts associated with visitation have the potential to impact on a much larger area if they are not monitored and managed. For example, there is a tendency for unmanaged walking tracks to widen over time as visitors leave the track to avoid fallen debris or other people using the track (Hammitt and Cole 1998), or to create their own tracks from campgrounds and picnic areas to waterholes or rest rooms.

Site use is unevenly distributed across the WTWHA, with a few sites receiving most of the visitation. These sites are also targeted by the tourist industry, e.g. Mossman Gorge and Daintree National Park (Cape Tribulation, Dubuji, Marrdja Boardwalks). It is in the best interest of the tourist industry that the environments they depend on are managed with minimal impacts. Land managers may have to distribute their time across several sites and consequently do not visit sites as frequently as many of the tour operators. Some impacts occur rapidly, e.g. vandalism, and therefore tour operators are best situated to detect and report these.

The level of impact caused by visitation at a site will depend on the resistance and/or resilience of the ecosystem. Resistance is the site's ability to tolerate recreational use without changing or being disturbed, whereas, resilience is the site's ability to recover from disturbance (Hammitt and Cole 1998). Impacts at WTWHA sites differ depending on:

- type of visitor, that is, free and independent travellers or clients of a commercial tour;
- level of visitation;
- attraction of the site, e.g. boardwalk, walking track, water fall; or
- geophysical and biophysical characteristics of the site and management practices already in place, e.g. hardened sites with boardwalks and railings to control visitor activities.

As a consequence, the rate at which different impacts occur varies across sites. In order for suitable management practices to be conducted, management agencies need to establish not only visitor numbers and visitor satisfaction levels, but also visitors' expectations, perceptions and biophysical impacts at a range of low and high use sites. These factors change over time and need to be monitored so that management can respond in a timely manner.

Tour operators have reported that in the past their observations and comments to management on negative impacts associated with visitation have not always been addressed. This highlights the need for a formal monitoring system that ensures their

concerns are recorded and, if necessary, acted upon. However, it is also important that different groups monitor identical items or indicators so that management can be informed of the level of concern. Therefore the first level of monitoring in the visitor monitoring system produced for the Wet Tropics Management Authority involves the tourist industry. The level of monitoring expected is simple, consisting primarily of yes or no responses.

Sites with low levels of visitation are primarily visited by the local community and the more adventurous independent travellers. The type of impacts occurring at these sites may be different than those at high use areas. Tour groups do not usually visit low use sites and thus land managers are the first level of monitoring at these sites.

Visitation and use of sites change over time so management agencies require a monitoring system that can track these changes and respond as necessary.

This section of the report provides the tools to be used in monitoring biophysical impacts at a visitor site. There are three basic levels to the monitoring: 1) tour operator rapid assessment; 2) land manager semi-rapid assessment; and 3) researcher semi-intensive assessment.

Ecological Impacts Associated with Visitation

Human visitation impacts on natural sites, particularly on vegetation, soil and hydrology. This occurs rapidly and the response tends to be curvilinear (Figure 1). Management agencies control this impact to a certain degree by hardening sites and concentrating visitation to certain areas. This can be done by clearing areas for camping and picnicking and promoting the growth of grasses in these areas, and clearing walking tracks and hardening them with surfacing such as decomposed granite, concrete or boardwalks.

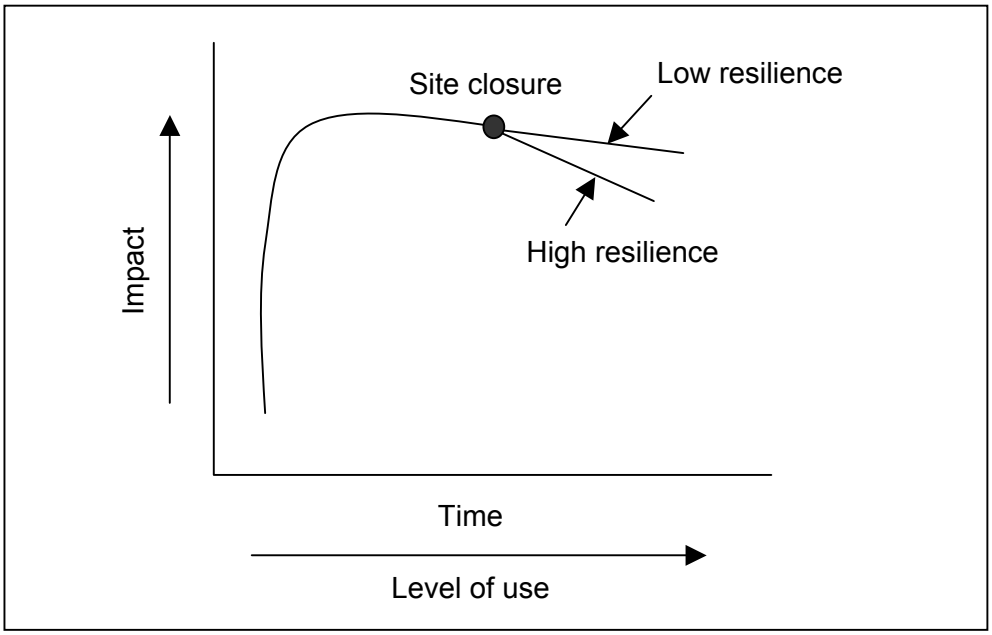


Figure 1: Curvilinear relationship between level of use, impact and recovery rates of natural sites exposed to trampling (adapted from Cole 1982).

Vegetation is particularly prone to trampling, although some species are more resistant than others (Sun and Liddle 1991). Vegetation is usually destroyed on the tread zone of heavily used areas such as walking tracks, and around core areas such as those associated with picnic tables and barbeques. At several sites within the WTWHA the management intent is to keep the area around the picnic tables and barbeques covered in grass, so the loss of grass around these areas needs monitoring.

In contrast, the tread zone of a walking track should be free of vegetation, and all impacts should be confined to this zone. High use areas where visitors step off the track extend the impact further into the forest through trampling of grasses, broadleaves and seedlings (the so-called buffer zone). This results in a reduction in abundance, height, vigour and reproductive capacity of the natural vegetation (Sun and Liddle 1993) and may result in the introduction of weeds into the buffer zone. Minor damage such as leaf destruction can impact on plants by reducing the area of photosynthetic tissue and thus the plant vigour (Hammitt and Cole 1998), allowing introduced species to proliferate along the edges of tracks (Cole 1978).

Trampling associated with visitation also results in a dramatic loss of organic litter. This occurs with a few passes by visitors (Hammitt and Cole 1998) and impacts on the soil in many ways, but particularly by reducing microbial activity and decreasing soil nutrients, and exposing roots, leading to their mechanical damage and increasing their susceptibility to pathogens.

A further impact on the buffer zone, from visitors stepping off the track, or into the forest surrounding camp and picnic areas, is soil compaction, which disrupts natural soil processes. These include decreases in infiltration, microbial activity, soil aeration, seed germination and the ability of fine roots to penetrate the soil (Kuss and Graefe 1985). This makes extraction of water and nutrients by plants difficult and may lead to the death of some plants. A loss of plants and the effect of the track edge may also lead to increased soil erosion adjacent to the track.

A study comparing trampling in eight tropical and subtropical sites found that sites with slight trampling had two times the soil penetration resistance of control sites; those with moderate trampling 3.5 times and those with high heavy trampling five times that of the control (Sun and Liddle 1993). However, the degree of soil compaction is influenced by organic matter, soil moisture, soil texture and soil structure with soils most prone to compaction being those with a wide range of particle sizes, low organic content and frequent moisture (Hammitt and Cole 1998).

Increased soil compaction causes a decrease in macropore space, decreasing the rate of infiltration and permeability of the soil and movement of oxygen and carbon dioxide (Jusoff 1989). Even low intensity rainfall causes erosion on soils with low infiltration rates (Jusoff 1989; Wallin and Harden 1996). Soil erosion is often associated with non-sealed carparks and internal roads within sites even on flat terrain in the Wet Tropics area. However, moderate to steep slopes are more prone to erosion than flatter areas. Once soil erosion starts on moderate to steep slopes it is very difficult to control (Wallin and Harden 1996). Soil erosion is also considered to increase in impacted areas during the wet season when rainfall is heavier and more frequent (Turton *et al.* 2000).

RATIONALE FOR A VMS FOR THE WET TROPICS WORLD HERITAGE AREA

The primary aim of this project is to design a robust, efficient, practical and cost-effective Visitor Monitoring System (VMS) for the Wet Tropics World Heritage Area and environs, which assists management in identifying whether visitor management objectives are being met so that appropriate management responses can be made. Figure 2 provides a simplified model of how the VMS will feed into nature based visitor management in the WTWHA.

The VMS considers whether management objectives are being met, and assists in understanding visitor patterns, demands and behaviours. Management response includes developing visitor management strategies that will result in positive trends (Figure 2).

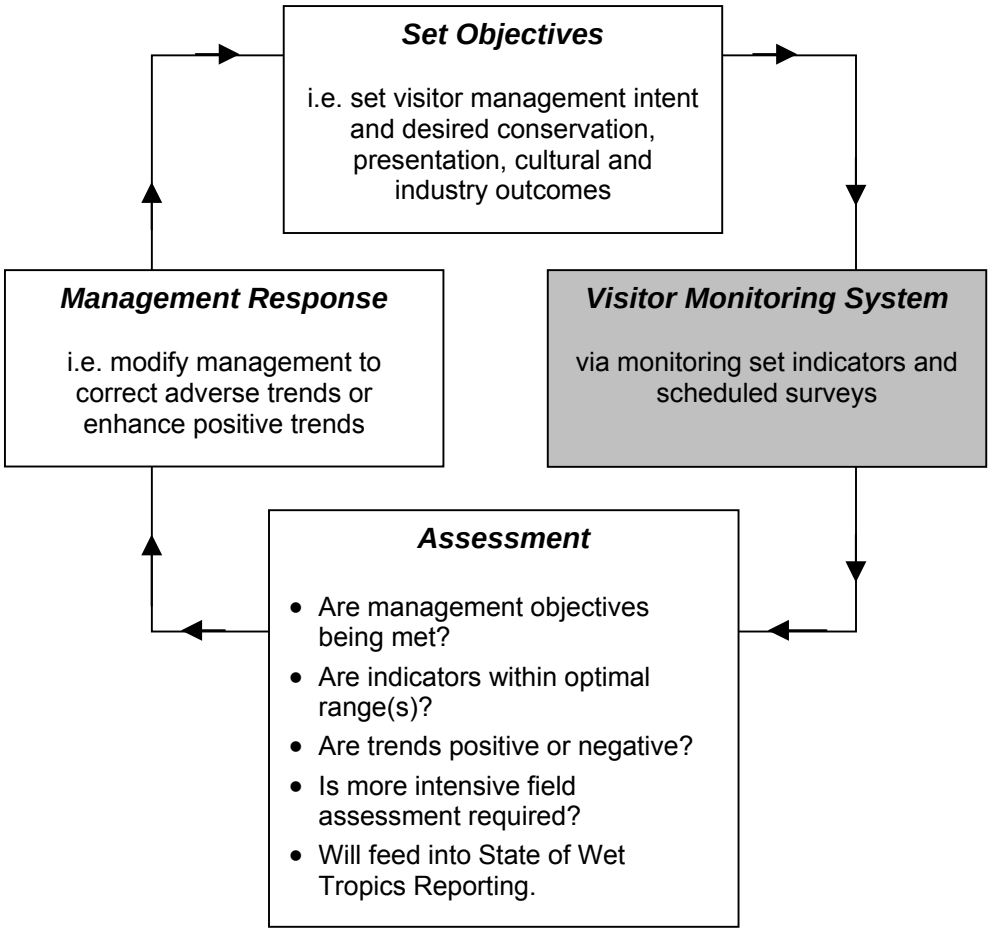


Figure 2: Model of the Visitor Monitoring System (VMS) and its relationship to nature-based visitor management in the WTWHA.

HOW THE VMS COMPONENTS LINK TOGETHER TO PROVIDE USEFUL INFORMATION FOR VISITOR MANAGEMENT

The following fundamental components were considered in the design of the Visitor Monitoring System (VMS):

- More than site based survey work (e.g. visitor numbers and satisfaction);
- Integrates both regional and site level approaches;
- Seeks to involve not only protected area managers but also the tourist industry, community and Indigenous partnerships;
- Efficient and cost effective;
- Operational (Tourism Queensland/Wet Tropics Management Authority challenge);
- Seeks to 'match' visitor demand (needs/expectations) with management supply of tourism 'product' and management objectives;
- Utilises a 'trend-based' indicator approach that focuses on whether trends are positive or negative and are within an optimal range;
- Incorporates response procedures, such as setting adverse trend 'triggers' that result in more focused monitoring and taking corrective action before serious environmental, social, management and industry impacts occur.

Regional components of the VMS include visitor pre-destination planning, arrival and departure and community attitudes. Site level components include traffic counts, which are verified by on-site observations of vehicle occupancy, visitor surveys, observations of on-site behaviour, and biophysical monitoring. These components are supplemented by qualitative information from tour operators, land managers and the Aboriginal community and together provide the data to trigger responses by management (Figure 3).

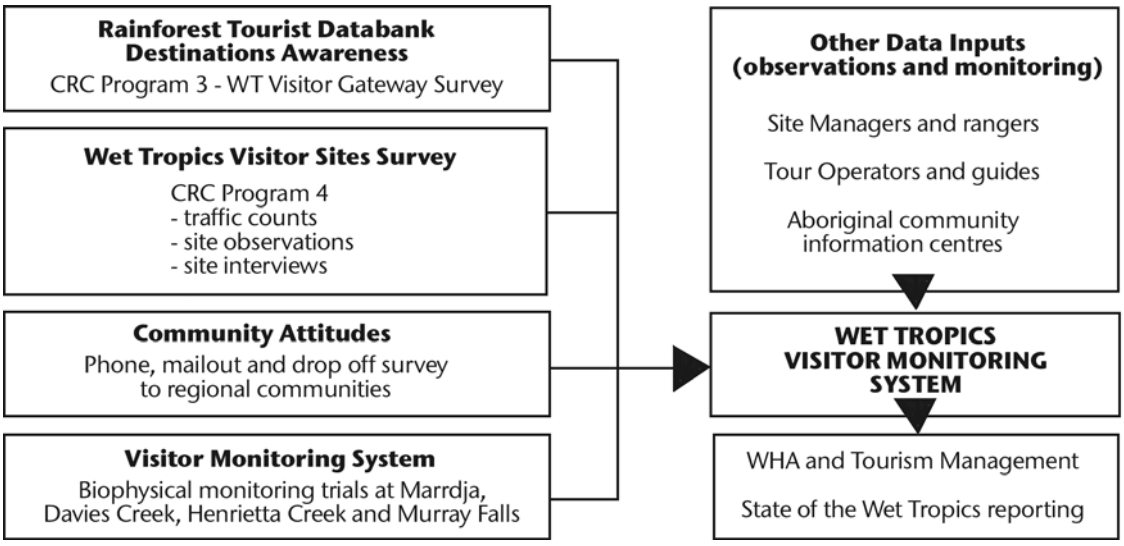


Figure 3: Flow chart of the components of the Visitor Monitoring System.

Models, Methods, Indicators and Integration with Respect to a Wet Tropics Visitor Monitoring System

Important objectives of the VMS project were to:

- review operating visitor monitoring systems and models in Australia;
- assess their utility and performance in the context of possible WTWHA use and/or adaptation; and
- in particular, look at indicators and linkages across levels of data collection and analysis, and methodologies across disciplines.

It was also very important, within the context of the WTWHA, to examine operating systems and initiatives, and assess where and how linkages, intersecting data collections, and existing archival data might be systematised, simplified, and integrated. Certainly it was the case that in the WTWHA, multiple and typically independent visitor monitoring exercises were being undertaken by management agencies, regional planning organisations, research organisations and university departments. Particular note should be made of the substantial investment of the Great Barrier Reef Marine Park Authority and the CRC Reef Research Centre in similar initiatives, albeit in the context of a marine property and protected area – but co-extensive to a substantial extent with the WTWHA.

There are many different survey strategies and many different models (e.g. LAC, ROS, VIM, TOMM, PADI; Appendix 1) for assessing the impacts of visitation and use in protected natural areas (e.g. Craik and Zube 1976; Craik and Feimer 1987; Gifford 1997, 2002; Graef *et al.* 1990; Hammit and Cole 1998; Irons 2001; Manning 1999; Margolis and Salafsky 1998; Stankey *et al.* 1985; Worboys *et al.* 2001). It is worth noting that most models, e.g. the Visitor Management Model from Hammitt and Cole (1998) and Machlis (1996) referred to in the VMS planning discussion papers, derive from a resource and planning context which is almost exclusively concerned with managing *the biophysical impacts* of recreational visitation and use, i.e. the 'ecological impacts'. Sources such as Machlis and Hammitt and Cole do not really address the impacts of *settings*, and *experiences* in settings, *on* visitors or the broader focus of the current VMS project, either with respect to indicator development or the actual documentation and monitoring of visitor experience or impacts. In this context this VMS has a more balanced approach to monitoring and managing visitation as it includes not only biophysical impacts of visitation and use but also the impact of settings and experiences on visitors.

HOW THE VMS LINKS WITH OTHER VISITOR MONITORING SYSTEMS AT THE NATIONAL, STATE, REGIONAL AND SITE SCALES

In this section we report on the visitor monitoring systems that are in use or being developed in Australia. We then address the focus of these Visitor Monitoring Systems and the methodologies and procedures being adopted. Most Visitor Monitoring Systems are being developed for protected areas by National Park Agencies (Figure 4).

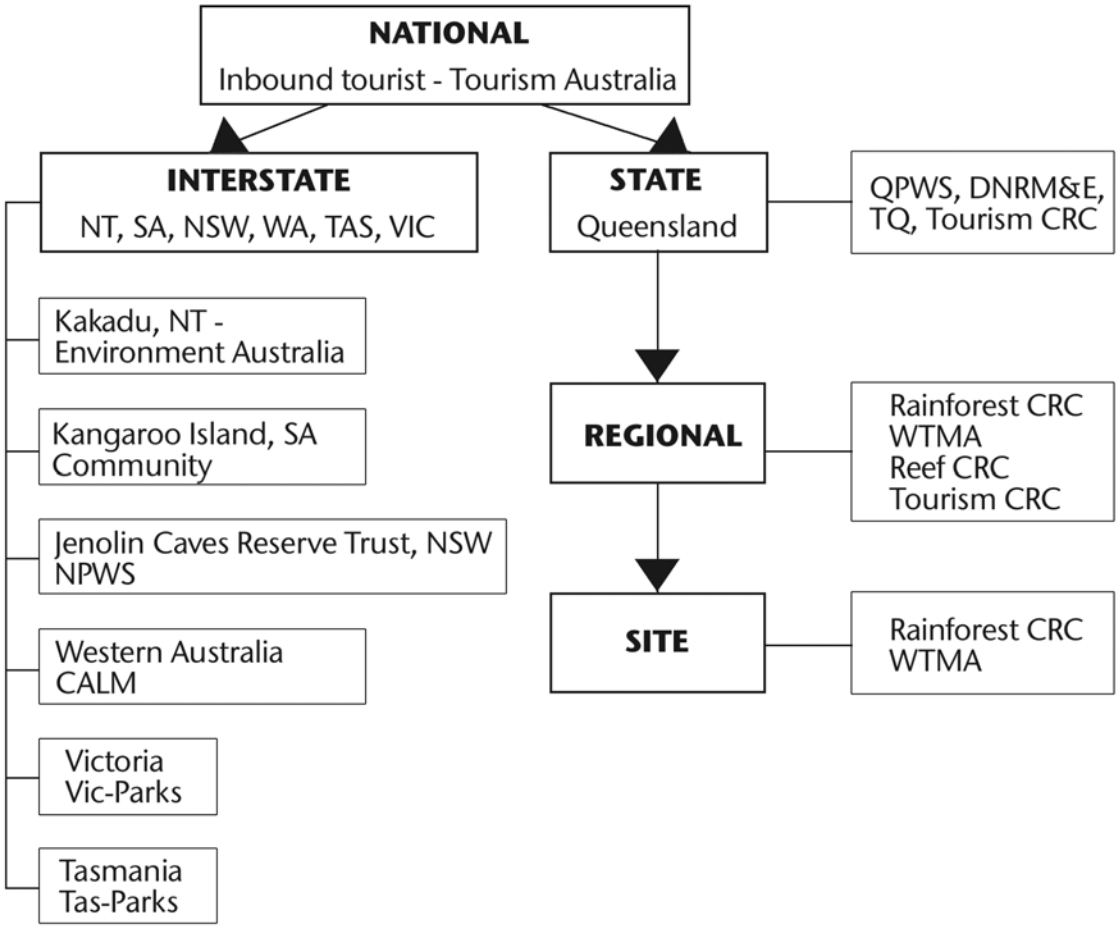


Figure 4: Agencies involved in Visitor Monitoring Systems identified at interstate, state and regional level, and the link between regional and site level monitoring (Definitions: *CALM* Department of Conservation and Land Management; *CRC* Cooperative Research Centre; *TQ* Tourism Queensland; *WTMA* Wet Tropics Management Authority).

National Level

Our review has shown that, to a large extent, existing systems and methods are serving very different objectives and addressing very different target populations and client/consumer audiences (Table 1). These systems are also operating across very different levels of analysis, as well as catchment areas. It is only at particular junctures that a regional tourist portal survey aligns with a site based visitor/user survey, or that a natural science driven monitoring exercise at a biological 'community' or 'population' level might coincide with a 'bioregional' community survey of local residents. Also, it is clear that what has been almost entirely missed in previous 'regional' visitor surveys is a good understanding of either the specific impacts of visitors at identified sites, or the impacts of specific sites or the WTWHA as a whole on visitors in terms of experience, or attitudinal or behavioural change.

Table 1: Visitor monitoring programs currently in operation in various states of Australia. Other systems do exist but do not have the breadth of those reported here.

Regional Locality	Type of Monitoring System	Features	Limitations	Commonalities	Evaluation	Reference
Kakadu National Park, Northern Territory	Predominant focus on visitor satisfaction.	Survey questions relate to: source, sex and age, travel mode, reason for visiting, duration of visit, sites visited, types of activities undertaken, satisfaction with infrastructure and condition, information services, perceptions of crowding, crocodile hazard, the negative impact of sunscreen and insect repellent on water quality.	• Does not address biophysical indicators or culture. • Site level and intermediate programs (Kakadu is extensive). No regional level.	• Visitor satisfaction with infrastructure condition, activities during stay, perceptions of crowding. Only to the extent of the components of visitor surveys. Some psychosocial, no biophysical.	• A fairly typical visitor survey. • Not designed to monitor condition, or biophysical and other impact. • Frequency ongoing. • No biophysical, so no surveys in concert.	*Kakadu National Park Visitor Survey*, Environment Australia
Western Australia	Analytical and predictive.	Measures visitor numbers and visitor satisfaction. Predictions of visitor activities site specific. Monitors condition, but not correlated to visitor activities. Does not collect any data on impacts of visitation. Collects user numbers on vehicle counters.	• Does not collect any data on impacts of visitation. • Research on indicators for biophysical monitoring, but none at present. • Site level only.	• Monitors condition of the locations being visited, however not correlated to visitor activities. Collects user numbers on vehicle counters. • No surveys in concert.	• A fairly typical visitor survey at this stage. • Not designed to monitor condition, or biophysical and other impact. • Frequency ongoing. • No surveys in concert.	Ingram, C., Manager, Park Policy and Tourism Branch, Department of Conservation and Land Management (per email 20/6/2002).
Jenolan Caves, New South Wales	Analytical and predictive.	Visitor Monitoring Process (VMP) indicators developed to measure stated goals and objectives implicit in issues identified through past research. Tools include visitor questionnaire, visitor comments register, meetings with coach companies, cave tour ticket sales, occupational health and safety process.	• Wholly oriented towards visitor satisfaction. • No actual biophysical indicators used. • Management plan is site-specific, i.e. peculiar to a cave experience. • No regional component.	• Visitor satisfaction with infrastructure condition, quality of experience, etc. • Monitoring against trends. • Triggers are numeric and if the results reach or surpass a trigger point, management action is warranted.	• A thoroughly researched and implemented management and monitoring plan. • Frequency ongoing. • No biophysical component, therefore no synergy with psychosocial.	*Visitor Monitoring Process.* Draft Report 23/03/2002. Jenolan Caves Reserve Trust

Regional Locality	Type of Monitoring System	Features	Limitations	Commonalities	Evaluation	Reference
Mornington Peninsula, Victoria	Analytical.	Flora and fauna surveys, including flora of significance. Monitoring of geological and geomorphological features including dunes. Monitoring and archiving condition and management of cultural features. Weed and feral animal control. Management plans for walking tracks and other visitor use areas. Monitoring numbers of visitors and patterns of use. Risk and hazard mitigation program.	• A comprehensive management strategy with few limitations, yet no information is given as to what biophysical psychosocial or other indicators are being used or are to be used. • Site, intermediate and regional levels.	• Vegetation monitoring. • Cultural assessment. • Weeds and feral animal control? • Recording? • Visitor numbers.	• A three-year rolling implementation program will be prepared for the park to ensure efficient implementation of this plan. • No indication given as to current time-lines. • This is the most current download (Sept 02) from the Parks Victoria website. • No apparent synergy of survey components.	Mornington Peninsula Management Strategy, Parks Victoria. 'Implementation', www.parks.vic.gov.au
Tasmanian Wilderness World Heritage Area	Analytical.	Recording of biophysical impacts: on vegetation, soils and geomorphological features, changes to track and campsite conditions. Other biophysical including litter, pollution, exotics and pathogens, drainage and hydrology, disturbance to fauna, vandalism. Social impacts such as encounters, crowding, noise and visual intrusion. Impacts of management in users. Impacts on cultural, aesthetic and recreational values from biophysical changes, changes in use patterns, loss of naturalness, increased hazards to user safety.	• Very few. This is a thoroughly researched management strategy, although relying on work done mostly in the USA and Europe. • Site and intermediate level (i.e. walking tracks are extensive). • Does not address regional level.	• Similar in many respects to the style/type of indicator and measure developed for the Wet Tropics VMS. Social impacts and impacts on cultural aesthetic and recreational values more extensive and thorough including encounters on tracks, crowding and loss of mystery. • Biophysical and psychosocial surveys in concert.	• Proformas used for the inventory were not sighted, although it was noted that the format was revised and finalised. No significant bias was observed between the estimates of the three staff members involved, although the entire track inventory was undertaken by one field officer. • Frequency one-off. • Future unknown. • Biophysical and psychosocial surveys in concert.	*Walking Track Management Strategy for the Tasmanian Wilderness World Heritage Area.* Tasmanian Parks and Wildlife Service 1994. Tasmanian Department of Environment and Land Management Hobart.

Regional Locality	Type of Monitoring System	Features	Limitations	Commonalities	Evaluation	Reference
Kangaroo Island, South Australia	Experimental and predictive. LAC and TOMM.	TOMM does not concentrate on impacts or setting limits for use, but instead emphasises optimum and sustainable outcomes for tourism and the community, and sets acceptable ranges within which they should occur.	• Claims to address biophysical and socio-cultural indicators, however seems that indicators for key areas still in the development phase. • Regional only. No details of site level surveys at this time.	• Ecological and socio-cultural indicators included so as to reflect the entire tourism system, i.e. a more regional perspective. • Very different in overall emphasis.	• A holistic management model, which if finally properly implemented with appropriate indicators, will be an excellent achievement. • Frequency unknown. • Biophysical and psychosocial surveys not in concert.	Jack, L., 2002. *Development and application of the Kangaroo Island TOMM (Tourism Optimisation Model).* Future of Australia's Country Towns. www.regional.org.au/au/countrytowns/options/jack.htm

State Level

It is important to stress that very few, if any, currently employed protected area or outdoor recreation survey instruments or procedures have attempted to address the breadth of considerations or variable domains addressed in the survey instrument developed in Rainforest CRC Project 4.1 or 4.5 (Bentrupperbäumer and Reser 2002a; Volume 2, this Best Practice Manual) and accompanying site and audit procedures utilised. Nor have they attempted to employ a hierarchical system of collecting biophysical data in monitoring impacts of visitation and use. The very narrow and selective foci of existing instruments and indicator suites, and in particular the omission of meaningful psychological or genuinely social parameters, have indeed been a major criticism and shortcoming of earlier surveys (e.g. Bell and Morse 1999; Cordell and Bergstrom 1999; Manning 1999; Reser and Bentrupperbäumer 1999, 2001b; Williams *et al.* 1992).

Level of Monitoring Conducted at the State Level

Western Australia

Department of Conservation and Land Management (CALM) manages over twenty million hectares of Western Australian land and waters (Department of Conservation and Land Management 1999). Included in these lands and waters are many of the state's principal nature-based recreational and tourism attractions. They have developed a monitoring system that provides information on visitor numbers (traffic counters) and visitor satisfaction (surveys). Currently it does not involve biophysical monitoring although work on biophysical impacts of visitation is being conducted (pers. comm. Smith 2002). The technology and software (*MetroCount*) used to gather their traffic counts is the same as that used in the WTWHA.

Queensland

Environmental Protection Agency (EPA), Queensland Parks and Wildlife Service (QPWS) and Dr Louise Horneman, 1999, Gatton Campus, University of Queensland, conducted a survey of protected areas across the State in 2001, but this did not include the WTWHA (Horneman *et al.* 2002). Their survey investigated visitor activities and satisfaction focusing on protected areas in the south of Queensland and in National Parks of New South Wales. Information from their project will provide information for QPWS about visitation in the southern part of the state but may not reflect the situation in the Wet Tropics. A second component of their study was a series of workshops on visitation and use of protected areas conducted across the state with rangers and managers. This VMS linked to two of these workshops conducted in Cairns in 2001. Rainforest CRC researchers, Department of Natural Resources and Mines (NR&M), QPWS, and Wet Tropics Management Authority staff participated in these workshops which addressed what was being done in visitor monitoring within the state and how we could best complement our activities.

Examples of Regional Visitor Surveys and Supporting Material

The NR&M Recreational Unit, now part of Queensland's Environmental Protection Agency (EPA), were using a modified ROS system to monitor and control visitation and use of Forestry Recreational sites. Rangers involved in this monitoring assisted in identifying indicators for use in the VMS.

In 2000, NR&M produced a series of eight technical reports on the Barron River Catchment, containing information on one of the major catchment areas in the WTWHA. Although these reports are not part of a visitor monitoring system they do provide information that can be linked to visitation and use in the area that impacts on the WTWHA.

In 2001/2002, a sub-project within Rainforest CRC Program 2 was developing economic indicators for use in the WTWHA using a 'travel cost' survey of visitors to the Wet Tropics region. Results from the project will provide economic links for use in visitor monitoring in the future. This particular project built on earlier studies conducted by Manidis, Roberts and Driml in the Wet Tropics area.

Indigenous cultural links are provided by the following reports:

- Irvine (2000), *Barron Basin Water Allocation and Management Plan*. Draft Technical Report 7, Indigenous. Report in consultation with the Indigenous community of Barron WAMP Study Area.
- Bentrupperbäumer, Hill, Peacock and Day (2001), *Mossman Community*. Report prepared for the Mossman community by Rainforest CRC.
- Smyth (2003), *Cultural Indicators*. Report on cultural indicators using the Murray Falls community (Jumbun) as a case study. Report prepared for Rainforest CRC and Wet Tropics Management Authority.
- Horsfall (unpub), *Survey of the Indigenous community of Wooroonooran National Park*.

In the pursuit of a generic set of standardised indicators and methodologies for integration in the VMS for the Wet Tropics Management Authority, we found that other visitor monitoring systems being used or developed in Queensland and nationally (e.g. Hornemann 1999; Manidis and Roberts 1997; Moscardo and Ormsby 2000; Ormsby *et al.* 2000; QDE 1998) have been largely tourism focused 'regional' surveys with a characteristic tourist and market profiling set of objectives. The methodologies of these other 'regional' surveys were also such that respondents were typically tourists, who completed a survey at transportation or information dissemination nodes, while *en route* to and from particular tourist destinations. Hence the target population and methodology of these surveys was quite different than what is necessary when examining the reciprocal impacts of visitation and use across more diverse groups of visitors and users at a visitor site level, or when undertaking a resident-focused community survey relating to the impacts of the WTWHA, or WTWHA visitation and use, on local residents and communities (Table 2).

Table 2: Summary of types of impacts visitation can generate and how they impact at a regional, community and site level (modified from Kees Lindenberg, pers. comm.).

	Experiential	**Ecological**	**Economic**	**Social/cultural**
Regional (general public)	Open areas that provide quality experiences.	Ecological health – water shed, atmosphere.	Create economic growth for region.	Maintain cultural integrity of areas but in comfortable settings.
Local community	Displacement.	Desire to maintain local healthy environment.	Local employment.	Interest in cultural heritage or destruction of them.
Site level	Crowding.	Site degradation.	Site development – infrastructure.	Displacement.

Community Surveys – Regional or Site Level Perspective?

Clearly a community survey attempts to capture *community* attitudes, perceptions and concerns. If the real intent is to gather data representing a *region*, then the differing communities in the region must be sampled in such a way that the profile of the *regional community* can be accurately described and documented. An important issue, however, is that much of the information sought in community surveys is actually individual level data, which must then be aggregated to provide a 'community' perspective. This is certainly true for psychological parameters such as attitudes, perceptions and concerns, though less the case for overall patterns of use, where these can be established through archival data sources, such as traffic counters, licenses issued, or site maintenance costs.

In the context of the current Wet Tropics Management Authority community survey, there had been a number of previous surveys undertaken, but few items were suitable for inclusion in this commissioned survey. Reasons included the fact that the items in previous surveys differed markedly across surveys; the methodology of the surveys differed substantially; and the objectives of the earlier surveys were quite different. The listing of the WTWHA was marked by considerable public controversy and local opposition and earlier surveys were undertaken, in large part, to monitor and demonstrate public support for government and agency policies and initiatives (e.g. McDonald and Lane 1999). The current community survey was much more focused on understanding how local residents saw and assessed the extent to which the WTWHA played any substantive or particularly meaningful or valued roles in the life of adjacent communities.

State or national level environmental indicators relating to community perceptions, impacts, or judgements of relevance that might exist (e.g. Alexandra *et al.* 1998; ANZECC 2000; BBC Consulting 1994; DEST 1994) were not available, with the exception of four suggested indicators relating to 'local and community uses':

- number of visitors to far north Queensland and Wet Tropics tourist sites;
- percentage of population with a high concern for the environment;
- ranking of specific environmental concerns among population; and
- percentage of population satisfied with environmental management.
  (Alexandra *et al.* 1998, 72-73; ANZECC 2000; Reser and Bentrupperbäumer 1998).

It is noteworthy that two of the above four nominated indicators in the ANZECC review relevant to local and community uses and perceptions of the environment refer to environmental concerns.

Site Level

While the emphasis of much 'tourism' or 'visitor studies' research is on a more socio-economic, market-oriented evaluation of and/or profiling of visitor/consumer backgrounds, preferences and motivations, the focus of the current site based survey research was a more management and planning-focused exploration of the nature of the encounter visitors have in the WTWHA, and aspects of their experience and behaviour which have direct implications for management, whether these relate to protection of the natural environment, the presentation of World Heritage 'values', or achieving sustainable visitation practices and policies. Additionally, an important research focus of the current survey research was to explore:

- to what extent the on site perceptions and judgements of visitors and users – of their own experiences and responses and the status and condition of the external – could be used as important indicator domains or measures; and/or
- the basis for site design or behaviour change strategies, which might mitigate negative biophysical impacts while fostering positive psychosocial impacts.

Social science surveys provide an efficient and valuable multi-level methodology for obtaining a range of information on visitor behaviours and otherwise inaccessible experiences, as well as on the perceived condition and adequacy of environmental attributes and amenities. An important distinction between the currently utilised, site-based survey instrument and other often-used regional surveys and community surveys is that the wording of the items and question content refers to visitors' immediate surroundings and experiences, and events that are very close in time to their verbal reporting. Surveys using an on-site methodology and approach are in effect asking respondents to comment on aspects of their 'internal environment', their external environment (natural and human-designed, and social), their behaviour and activities, and their overall experience in a particular environment. For a number of items respondents were able to refer to their still immediate physical and social environment, and to emotional responses and sentiments that were still very salient and immediate. In these respects such a site-based, in-situ survey has considerable ecological validity, and is not subject to many of the distorting biases of recalled experiences at more distant points in time and location. Such site-based surveys also allow for a clearer and more discrete documentation and monitoring of specific site-influenced behaviours, perceptions and experiences. Finally, this site-based approach allows respondents to make judgements about the perceived condition and state of specific site attributes, and the collection of valuable 'observer-based *appraisals*' to complement expert and/or instrument-based *assessments* (e.g. Gifford 1997, 2002) and allow linkages with the biophysical measures undertaken in the VMS project (Volume 2, this report).

HOW THE VMS IS COMPLEMENTED BY OTHER RESEARCH AND SURVEY ACTIVITIES

There are a number of current Rainforest CRC initiatives, for example Projects 4.1 and 4.5, discontinued research (Program 3) and ongoing research projects (Project 4.1) which are of particular relevance to the VMS project. For the past five years, Rainforest CRC Program 3 has undertaken a regional approach to exploring motivations, experience and satisfactions of the visitor, and tourism-community relationships and the impacts of tourism on the regional community (e.g. Pearce 1988; Pearce and Moscardo 1997; Pearce, Moscardo and Ross 1996). Their approach has been to conduct visitor/tourist surveys at gateways and information centres.

Concurrently, Project 4.1 of the Rainforest CRC, 'Strategies for Sustainable Rainforest Visitation and Use', has been researching the psychosocial and biophysical impacts of visitation and use in the WTWHA (Bentrupperbäumer and Reser, 1998, 2000). This research has utilised visitor site based survey methods, community surveys, and a variety of other social and natural science based methodologies to better understand the multiple and reciprocal impacts of visitation and use in the WTWHA and adjacent bioregion. The scope of this integrated, multi-disciplinary research program has included *all visitors and users* of the WTWHA (including local residents and national and international tourists, council employees, researchers, indigenous residents, and virtual users), as well as the impacts of visitation and use of the WTWHA on adjacent regional communities.

While the focus of this research program has not been on tourists or tourism *per se*, this largely site-based approach examines the behaviour and experiences of local visitors, and interstate and international tourists, as they pass through, encounter, and impact upon World

Heritage Area visitor sites. An integral component of this research and current Projects 4.1 and 4.5 is the development of meaningful and sensitive indicators of the psychosocial and biophysical impacts of visitation and use. This research focus includes, in an integrated, multi-disciplinary way, the impacts of this World Heritage environment *on* visitors and users as well as the impacts *of* visitors and users on the natural environment. Along with the development and standardisation of sensitive and meaningful *measures*, Projects 4.1 and 4.5 have made a substantial investment in the development of appropriate *models* and *methodologies* for both researching and monitoring such impacts, and providing useful data for better managing these impacts (e.g. Bentrupperbäumer and Reser, 2002a, 2002b, 2003; Reser and Bentrupperbäumer, 2000, 2001a,b; Volume 2, this report).

Two major surveys, that is, the site level psychosocial and the community attitudes surveys (Bentrupperbäumer and Reser 2002a, 2000b) have been major components of this VMS. They were designed in such a way as to complement previous site based and community surveys with respect to longitudinal monitoring and indicator development, and to provide information from four selected visitor sites which complemented the biophysical surveys (Volume 2, this report) and objectives and needs of the VMS project. Importantly the on site surveys undertaken included many local resident visitors (36%), so that there exists a useful cross-linkage with the community survey.

Simultaneous biophysical and psychosocial impact assessments at these four common visitor sites was achievable by conducting the VMS Project in concert with Project 4.1 in both the dry season of 2001 and wet season of 2002. While Project 4.1 has undertaken simultaneous and integrated biophysical and psychosocial assessments in previous research (e.g. Bentrupperbäumer and Reser, 2000), the current site based contract survey of Project 4.1 had a more exclusive focus on *psychosocial* impact assessment and monitoring and related indicator development (Reser and Bentrupperbäumer 2001b). From a VMS perspective, the ongoing psychosocial survey of these selected sites during the wet and dry season provided a natural comparison point, and efficient and convergent opportunity for exploring what types of methodologies and measures might be most appropriate to an integrated assessment of biophysical and psychosocial impacts and a standardised VMS for the WTWHA and adjacent bioregion. The incorporation of these common sites and collaborative data collection also allowed for more of a natural resource management oriented social and behavioural science input to the VMS project than might otherwise have been the case.

Site-based Visitor Survey

The current surveys, and previous survey research, were undertaken in the absence of an articulated or formalised WTWHA longitudinal research strategy or data base program which might guide future research, the standardisation of methods and measures, or strategic monitoring over time. We trust that such systems will be set in place, in the context of an informed bioregional assessment mandate and structure (e.g. Johnson *et al.* 1999; WTMA 2000), and that this current data set will help to establish such a database and monitoring system. Indeed, the WTWHA VMS would directly feed into such an initiative and undertaking.

Measures and procedures for the current surveys were developed within the larger context of World Heritage Area management and State of the Environment Reporting indicator development (e.g. ANZECC 2001, 2000; ASEC 2001; Bell and Morse 2000; DEST 1994; Eckersley 1998; Hamblin 1997; Hockings 2000; Newton 1998; United Nations 1996, 2002; WHU 1998), with reference to developments with respect to biophysical and social and psychological impact assessment and indicator development in Australia and internationally (e.g. Bright *et al.* 1999; Cordell and Bergstrom 1999; Dale *et al.* 2001; Hall and McArthur 1996; Thomas 1998; Hammitt and Cole 1998; Manning 1999; Vanclay 2002; Vanclay and

Bronstein 1996; Worboys *et al.* 2001), and with a conscious awareness of the critical need for the inclusion of social science approaches in World Heritage Area monitoring and management generally (Becker and Jahn 1999; Lawrence *et al.* 2001; Reser and Bentrupperbäumer 2001a,b; Sheppard and Harshaw 2001).

Community Survey

The undertaking of a community survey to both complement the site based survey and the VMS initiatives, and address other, independent objectives, was mooted and incorporated into the ongoing research program of Rainforest CRC Project 4.1 in 2001 (Bentrupperbäumer and Reser 2002b).

An important objective of the community survey, as distinct from the site-based survey, was to enable comparison of data collected within this project component with previous AGB community surveys, undertaken in 1992, 1993, and 1996, and a 1999 'WTWHA Neighbours' survey (AC Nielsen 1999). It was acknowledged from the start, however, that the nature and direction of these previous surveys was inadequate for current planning and management needs, and that the present survey would be both broader in scope and more complementary to the companion, site-based survey being undertaken simultaneously by Project 4.1 of the Rainforest CRC (Bentrupperbäumer and Reser 2002), and if possible, to other visitor monitoring surveys being undertaken elsewhere in Queensland and Australia (e.g. Horneman 1999; Moscardo and Ormsby 2000; NSWNPWS 2001; QDE 1998).

The scope of the three year collaborative development project between The University of Queensland, Queensland Parks and Wildlife Service, Department of Natural Resources, Mines and Energy, and the New South Wales National Parks and Wildlife Service, and the separate Great Barrier Reef Marine Park Authority initiative and ongoing program were potentially most relevant to our own research program and specific survey undertakings, however, these programs advanced quite independently of our own Rainforest CRC initiatives with respect to the development and standardisation of measures, methods and indicators for site-based and community monitoring in a time frame and context which did not allow for substantive collaborative exchange.

HOW THE VMS MIGHT BE ENHANCED OR UPGRADED WITH ADDITIONAL DATA FROM OTHER SOURCES IN THE FUTURE

With respect to a fully operational and satisfactory VMS, it is likely that two or more independent 'systems' will be adopted and implemented. The first will focus on site level and resident community management, and reporting needs relating to changes and impacts resulting from all human visitation and use. A second tourism planning and industry sponsored system will have a clearer focus on the monitoring of visitation patterns and profiles, destinations and decisions for those tourists visiting the WTWHA bioregion, and more generally, far north Queensland.

The more 'regional' tourism planning and industry sponsored system will in any case need to articulate with other state-wide and national tourism monitoring enterprises, and serves rather different needs and requirements, though their findings are nonetheless of particular interest and relevance to protected area management, especially with respect to the assessment and quantification of changing 'pressures' and preferences, and both visitor satisfaction and tourism-related economic benefit.

PRE-DESTINATION MONITORING

Figure 5 shows how the Visitor Monitoring System (VMS) relates to the full travel sequence, and Table 3 provides guidance in terms of visitor/management elements, monitoring questions and monitoring techniques for the various stages in the travel sequence. Each stage would require the development of a separate survey instrument that must be closely aligned with the VMS.

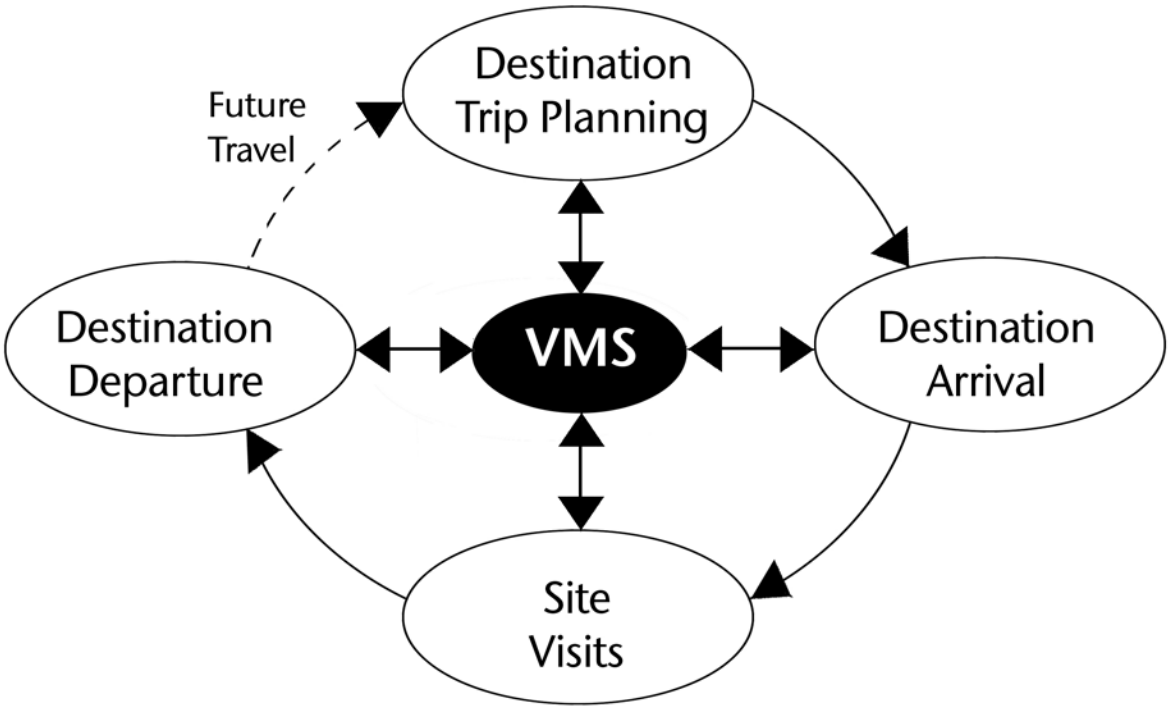


Figure 5: Relationship between the VMS and the full travel sequence.

Pre-destination monitoring should include approaches such as those previously used by Bentrupperbäumer and Reser (2000, 2002) in surveying tourist brochures and other marketing information (Table 3). There should also be reference to Wet Tropics Management Authority's *Style Manual and Image Library* to monitor whether appropriate information and images are being used in marketing campaigns for tropical north Queensland. The tourist industry should be in a position to assist with such monitoring, such as during trade shows and at the wholesale marketing level. Monitoring of web site information should also be employed, perhaps by the tourist industry itself.

In the case of arrival and orientation information, some of Moscardo and Ormsby's (2000) survey questions could be applied here (Table 3). There are also questions that could be asked at information counters, gateway points, Wet Tropics information centres, care hire outlets and key visitor arrival sites, such as Pier Market Place and the Esplanade development in Cairns. The visitor monitoring process from pre-destination to post-destination is examined in detail in Volume 2 of this series.

Table 3: Strategic framework for tourism management elements and monitoring questions and potential monitoring techniques for key stages of the full travel sequence.

Stage of Visit	Tourism and Management Elements	Monitoring Questions	Potential Monitoring Techniques
Planning the visit	• Marketing and promotions • Trip planning information • Package Tours	• Accurate information? • Appropriate images? o visitor behaviour o deliverable opportunities	• Industry partnerships, assistance, e.g. wholesale agents. • Internet searches • Research surveys of available tourist information
Arrival at destination / Accessing the site	• Visitor orientation • Site and route information • Product themes • Wet Tropics interpretation and presentation • World Heritage awareness information • Free and independent travellers	• Is visitor information readily accessible? o Information centres o hard copy o touch screens • Information interesting, understandable and relevant? • Feedback on pre-arrival information. • 'Matching' of visitor interests / expectations with products?	• Rolling surveys at visitor centres • Link with regional scale tourism surveys, e.g. CRC, tourism bodies.
Onsite visit	Nature Based Tourism Product: • Nature based recreation opportunities • Natural and cultural setting • Visitor facilities and information • Management services	• Visitor profiles, activities, level of use? • Reason for visit, expectations 'matched' with product? • Visitor experience? • Visitor behaviour? • Site facilities, information, management services? • Biophysical impacts?	• Site surveys and observations • Traffic counters • Regular site monitoring: o rangers o tour operators • Touch screens? • Researchers • Aboriginal interests • 'Eye-balling' to robust scientific indicators • Trend 'triggers' for more focused monitoring
Point of departure / Post site visit	• Farewell by tour industry, management • Mementos, souvenirs	• Visitor reflections on Wet Tropics tourism product • Experience 'highs' and 'lows' • Expenditure • Patterns of tourism in TNA and Wet Tropics	• Surveys at: o Departure points o Major travel routes

SECTION 2:
PROCEDURES AND PROFORMAS FOR MONITORING BIOPHYSICAL IMPACTS OF VISITATION

SECTION 2: PROCEDURES AND PROFORMAS FOR MONITORING BIOPHYSICAL IMPACTS OF VISITATION

INTRODUCTION

Section 2 provides the procedures and proformas for conducting a biophysical monitoring program at a site level in the WTWHA. Biophysical impacts in this context refer to impacts on the natural environment, and visitor infrastructure. The methods and indicators chosen for this VMS allow basic visitor monitoring and use simple, robust, and cost-effective measures. This VMS is designed to identify positive, neutral and negative trends in the environment, infrastructure and services at a site. If negative trends are identified, then the action that is implemented will depend on the nature, severity and source of impact, management intent and current management in place.

The procedures and proformas were designed for a tropical rainforest setting but may be applied to other natural settings. The type of monitoring required is presented in order of increasing complexity, that is, from rapid assessment to detailed fieldwork.

In accordance with the terms of reference this section includes details on:

- how the site monitoring components should be set up, and
- how the survey components should be applied.

Why Monitor?

Visitors to sites, whether on tours or as independent travellers, impact on the natural environment with the potential to affect the quality of a site. The condition of the site also impacts on the visitor (Bentrupperbäumer and Reser 2002a). Monitoring allows early detection of potential problems and thus assists in the preservation of a site and allows management to identify whether or not their objectives are being met.

How the Monitoring and Survey Results Should be Interpreted to Provide Robust Information to Management

Management set the objectives on which the monitoring is based (Figure 6). Monitoring then takes place – the results of which are used to trigger a response from land managers. This may be a direct action by land managers or require re-assessment of the management intent and objects. To determine what type of action should be taken we have included in the protected area manager assessment forms a column where the assessor identifies whether:

- impact requires watching;
- impact requires attention in the next three months;
- immediate attention is required; or
- action is being taken.

Note, a precautionary principal applies when making decisions about visitation that poses a risk to visitors or the environment with potentially serious irreversible impacts.

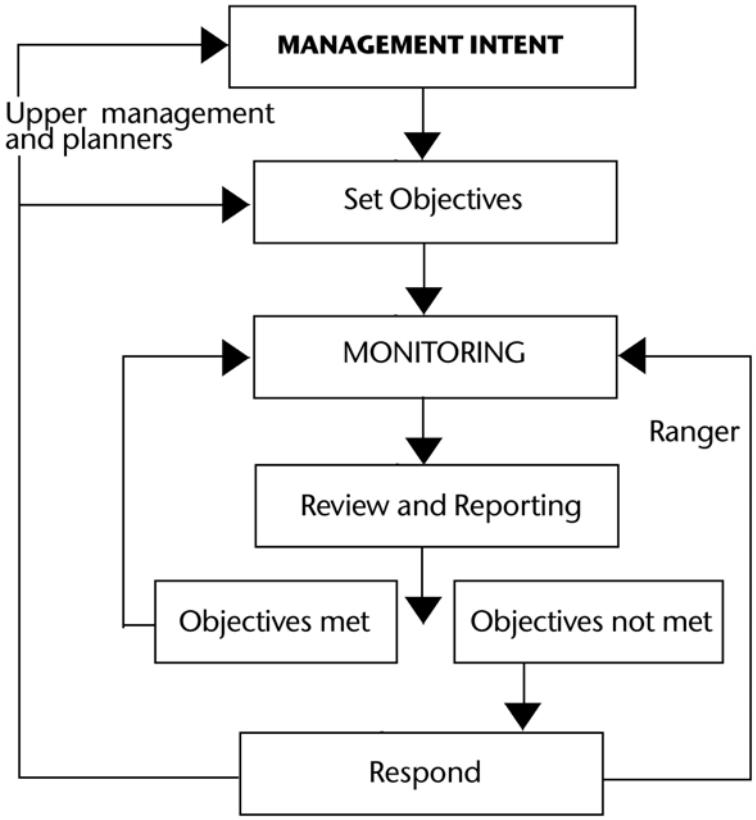


Figure 6: Flow chart showing decision-making process.

How Indicators Were Identified

Indicators included in the proformas were identified and collated from research and consultations with members of the tourist industry and protected area managers. The indicators used in the monitoring undertaken by the field researchers were identified from previous studies conducted overseas (Hammitt and Cole 1987) and in the WTWHA (Bentrupperbäumer and Reser 2000) and trails conducted at four study sites (Figure 7).

Process in Developing Biophysical Indicators

- Consultation amongst research team;
- Reference to previous studies in WTWHA;
- Trial of indicators in wet and dry season;
- Site analyses;
- Prioritisation of best indicators for each site; and
- Identification of indicators that are appropriate across sites.

Importance of Stakeholder Involvement in Developing a Monitoring System

Stakeholders are best able to identify:

- what they can monitor, what they see as important to monitor (this is important to ensure the monitoring is relevant to them and therefore done); and
- time and frequency that can be allocated to monitoring.

Land managers were asked what decisions they needed to make and what information they required to enable them to make these decisions in their day-to-day management of sites used by visitors. They were also asked to consider what they could realistically monitor and what equipment they had or would need to undertake this. Comments from land managers were important in the development of the proformas.

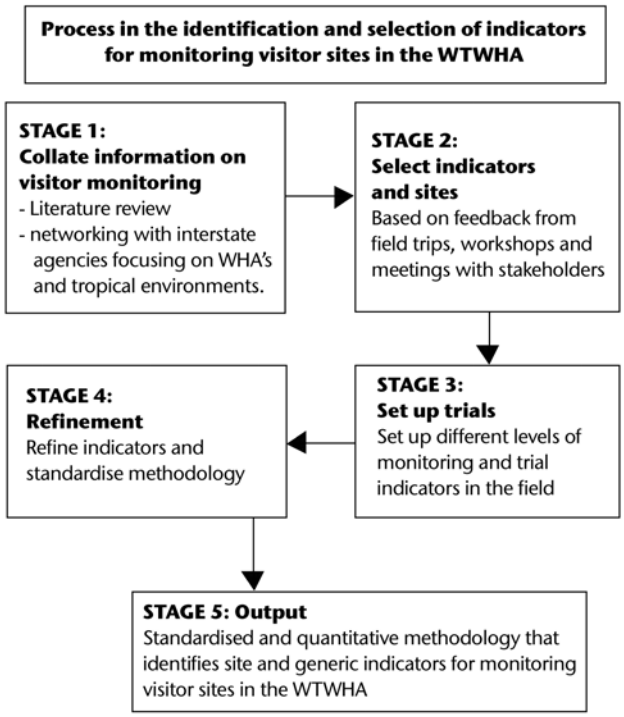


Figure 7: Flow chart showing indicator identification process.

Limitations in This System

- This system is based on a limited number of surveys and may need to be modified to include indicators that were not shown to be important at the time of monitoring.
- Wildlife human interactions are addressed at a rudimentary level at the tour operator and ranger level of monitoring but not at the field research level. At the field researcher level of monitoring this area requires more intense survey work. Suggestions for undertaking this valuable component of the monitoring are included in this report.
- Indicators for use in assessing water quality are included in the tour operator and protected area manager level of monitoring but not that of the field researcher. This is because the instrumentation and time required to conduct higher-level analyses of water do not fit within the requirements of this Visitor Monitoring System. It is recommended that water samples be taken for nutrient analysis (total nitrogen and phosphorous, ammonia, nitrate, nitrite and phosphate), chlorophyll a concentrations and faecal coliform on each of the ranger visits (see Australian Centre for Tropical Freshwater Research Report No. 16/96 pg. 12 for guidelines on collection of water sample). At sites where residues of sunscreen or personal insect repellent from swimmers are suspected, samples should be taken for analysis of these substances. However, pesticide analyses are very expensive.
- The set of protocols and proformas presented here do not include off-site regional level monitoring tools.
- A five-point scale has been adopted in the land manager proformas. This does not match the six-point scale used by Bentrupperbäumer and Reser (2000a) or the ten-point scale adopted by Moscardo (pers. comm. 2001). It is easier to convert the five-point scale to a ten-point scale, but not to a six-point scale. Scaling needs to be standardised across disciplinary areas to assist in interpretation of information.

Comment on Water Quality

It has been reported in research that human perception of water quality is strongly influenced by water clarity. There are several techniques that can be used to determine clarity but the easiest method, and one that correlates closely with human perception, is the horizontal black disc sighting technique (secchi disc) (Davies-Colley and Smith 1990 in Australian Centre for Tropical Freshwater Research Report No. 16/96). All of the streams were relatively shallow during these surveys and the use of a secchi disc to monitor clarity was not suitable. However, although most were stained with tannin they were not turbid.

TOUR OPERATOR MONITORING

Tour operators represent the first level of visitor monitoring and are very important in a visitor monitoring system in alerting land managers of problems, triggering immediate action and further intensive monitoring. It is recognised that tour guides make more frequent visits (often daily visits) than land managers to most sites and are thus in a position to give an early warning of impacts.

The purpose of this proforma is to:

1. monitor change over time;
2. increase awareness of changes in the environment;
3. assist rangers in identifying problems;
4. provide information to trigger land management actions; and
5. provide an early warning to trigger intensive survey work.

Process in the Development of the Proforma

Researchers in close consultation with Wet Tropics Management Authority staff have developed this proforma. The process used in its development involved:

a) meetings with researchers, Wet Tropics Management Authority staff and Tourism Alliance Group to discuss the framework of the VMS;
b) field trips with representatives of all stakeholders involved in visitation and use of Wet Tropics sites to discuss content;
c) development of a proforma by researchers;
d) field trips to trial proforma with researchers;
e) trial of the proformas with tour operators;
f) meetings with key stakeholders to discuss industry trial of proforma (Wet Tropics Management Authority, James Cook University and Tourism Queensland staff); and
g) final revision of the proforma by researchers.

Two field trips with representatives of all stakeholder groups: a field trip to Marrdja Boardwalk and a second to Davies Creek and Henrietta Creek was conducted in a small bus, to allow discussion *en route* with members of the Tourism Alliance Group, and staff of the Department of Natural Resources, Mines and Energy, Queensland Parks and Wildlife Service, Wet Tropics Management Authority and James Cook University. These sites represent three of the four sites chosen for the development of the WTWHA VMS and are readily accessible in a day; the fourth site, Murray Falls, requires more time. Marrdja is a busy tourist destination, whereas Henrietta Creek attracts few tour groups and Davies Creek has none. The objectives of these trips were to get an agreement on what we are trying to

achieve in visitation and use of Wet Tropics sites and to explore how the tour guides can assist with monitoring. During this field trip issues confronting tour operators visiting Wet Tropics sites were raised and discussed and have been taken into account in the development of the proforma.

Development of the proforma: following the field trips the researchers developed a proforma for use by tour guides that was considered relatively easy to complete, did not require actual species identification but monitored changes in the environment and peoples behaviour.

Trial of proformas with the tour industry: a presentation of the proformas was made to the FNQ Tour Operators Executive. The Executive was asked to identify tour operators who visited Marrdja and Mossman Gorge. The latter site was chosen, as it is a busy tourist destination and part of the visitor survey (Bentrupperbäumer and Reser 2002a). Tour operators operating at the two sites were identified from FNQ Tour Operators database and emails were sent out to companies inviting members to participate in the trial. A set of guidelines and proformas were sent out to the interested industry members and the trial was conducted over a six-week period.

A meeting was held with Mr Max Chappell (Wet Tropics Management Authority), Dr Robyn Wilson (James Cook University researchers) and Ms Emma Smith (Environmental Tourism) to discuss the content of the proforma and an associated consultancy conducted for Tourism Queensland, i.e. Operator Impact Monitoring Guidelines, Tourism Queensland.

A workshop/field trip with researchers and Wet Tropics Management Authority staff was conducted to review the proforma and ensure that all information to be collected was relevant to management needs. This resulted in further refinement of the proforma.

Arrangement of the Proformas

The proforma is divided into sections (activity nodes) to assist land managers in isolating areas of impact. The first section provides generic information, the second information on the car park and access road and the third information on the site. The latter is divided into two or three sections depending on what is available at a site, e.g. picnic area/camp area; car park/boardwalk/walking track; and freshwater features (see Tour Operator Proforma).

It is recognised that there are site-specific issues and these will be addressed for each site. At this stage only one of the four visitor monitoring sites (Marrdja) is being used on a regular basis by tour groups. Particular issues at this site include the use of bus parks by free and independent travellers and unauthorised tour groups, and visitors going the wrong way around the boardwalk. These have been included in both tour guide proformas but will be removed from proformas for use at other sites if they are not relevant.

Frequency of Sampling

It is recommended that all tour guides conduct this survey once a week and incorporate it into their tour. This will allow a temporal overview of the use of a site in a day and where more than one tour guide is visiting at the same time, the opportunity to compare responses.

Tour guides that are interested in carrying out more intensive monitoring, e.g. bird or mammal lists or focussing on specific issues e.g. use of the car park, feeding of wildlife, and die-back, are encouraged to do so and report changes to the rangers.

Benefits to Tour Guides

- Provides an avenue for involvement in management.
- Provides an opportunity to involve visitors in site monitoring.
- Provides a point of interest for their tour.
- Increases visitor awareness of their surroundings.

Table 4: Tour Operator Proforma.

TOUR OPERATOR: RAPID ASSESSMENT FORM

Monitoring the Well-being of the Wet Tropics

Site name / locality / GPS:				Person recording:	
				Tour Company:	
Date:		Arrival Time:		Weather:	☐ Sunny ☐ Overcast ☐ Raining

SECTION A: ACCESS ROAD - CARPARK – PICNIC AREA

(N.B. ACCESS ROAD = LAST 2KM BEFORE CARPARK UNLESS OTHERWISE SPECIFIED)

INFRASTRUCTURE:					
[1]**Parking** Are more vehicles present than designated parking space available? ☐ YES ☐ NO			[2]**Tour Bus Capacity** Up to 35seats: / More than 35 seats:	[3]**Number of Cars:**	
[4]**Access Road**	☐ Well Maintained	☐ Requires Maintenance	[7]**Facilities**	☐ Well Maintained	☐ Requires Maintenance
[5]**Carpark**	☐ Well Maintained	☐ Requires Maintenance	[8]**Facilities**	☐ Clean	☐ Dirty
Comments					
[9]**Hazards** ☐ Yes ☐ No (e.g. slippery or sharp objects, stinging plants or animals, star pickets, effluent)			**Comments**		

ANIMAL SIGHTINGS:						
[10]**Road Kills** (e.g. birds, reptiles and mammals)	**SIGHTED**	**No.**	[11]**Feral Animals**	**SIGHTED**	**No.**	[12]**Evidence of Pigs** ☐ Absent ☐ Sparse ☐ Common
	Birds			Dogs		**Comments** on sightings of unusual species (e.g. cassowary)
	Reptiles/amphibians			Pigs		
	Mammals			Cats		
				Others - rabbits, foxes		

WEEDS:	
[13] **Along Access Road, Carpark** ☐ Absent ☐ Sparse ☐ Common	[14] **Around Picnic Area** ☐ Absent ☐ Sparse ☐ Common
Comments	
INAPPROPRIATE VISITOR ACTIVITIES:	
[15]**Litter** ☐ Absent ☐ Minimal ☐ Extensive	[16]**New Vandalism Evident** ☐ YES ☐ NO **If yes, what? (**e.g. toilets, signs, vegetation)
[17]**Feeding of Animals/Birds** ☐ YES ☐ NO	[18]**Animals Scavenging Around Visitors** ☐ YES ☐ NO
[19]**Inappropriate Visitor Behaviour** (e.g. noise, stepping off track) ☐ YES ☐ NO	[20]**Visitors Taking Plants, Seeds, Flowers, Rocks, etc.** ☐ YES ☐ NO
[21]**Inappropriate Tour Operations:** ☐ YES ☐ NO **Comments** (e.g. no Commercial Activity Permit, inappropriate information or activities)	
Comments	

SECTION B: WALKING TRACK OR BOARDWALK

INFRASTRUCTURE:			
[22]**Track**	☐ Maintained to Standard	☐ Requires Maintenance	**Comments**
[23]**Signage**	☐ Maintained to Standard	☐ Requires Maintenance	**Comments**
[24]**Hazards** (e.g. slippery surfaces, loose rocks or stones or rails, exposed roots, stinging plants and animals, broken glass, sharp objects, fencing wire, star pickets, rotting boards) ☐ YES ☐ NO **Comments**			

INAPPROPRIATE VISITOR ACTIVITIES:	
[25]**Litter** ☐ Absent ☐ Minimal ☐ Extensive	[26]**New Vandalism Evident** ☐ YES ☐ NO **If yes, what?** (e.g. railings, signs, vegetation)

[27]**Inappropriate Visitor Behaviour** ☐ YES ☐ NO

Comments (e.g. walking off track, noise, breaking or taking plants, not following directional signs)

ANIMAL SIGHTINGS:

[28]**Feral Animals** Sighted or evidence	**SIGHTED**	**NO.**	**SIGHTED**	**NO.**
	Dogs		Cats	
	Pigs		Other eg. rabbits, foxes	

[29]**Native animals** Sighted or evidence

Birds ☐ Absent ☐ Sparse ☐ Common

Reptiles/amphibians ☐ Absent ☐ Sparse ☐ Common

Mammals ☐ Absent ☐ Sparse ☐ Common

Comments

Comments

CONDITION OF VEGETATION:

[30]**Patches of Canopy Death** ☐ Absent ☐ Sparse ☐ Extensive

[31]**Bracket Fungi** ☐ Absent ☐ On few trees ☐ On many trees

Comments

SECTION C: WATER SYSTEM

CREEKS OR RIVERS (N.B. FRESH WATER ONLY, NOT MANGROVE):

[32]**Surface film** ☐ YES ☐ NO

[33]**Offensive smell** ☐ YES ☐ NO

[34]**Litter** ☐ Absent ☐ Sparse ☐ Extensive

[35]**Clarity** ☐ Clear☐ Milky

[36]**Flow** ☐ Still ☐ Slow ☐ Fast

Comments

LAND MANAGER MONITORING

The second level of monitoring is to be conducted by the protected area managers. It is more intensive and comprehensive than that conducted by the tour operators and should be conducted less frequently, i.e. quarterly. The monitoring conducted by both tour operators and on-site land managers is designed to be complementary. There are three proformas for use at this level:

1. Camp and Picnic Area Proforma (Table 6)
2. Walking Track Proforma (Table 7); and
3. Water Feature Proforma (Table 8.)

A further component of the ranger monitoring is to construct a photographic record of the site over time.

Structure of the Proformas

Each proforma is divided into subsections as follows:

1. Camp and Picnic Area Proforma:
   - visitor related activity;
   - factors related to human disturbance of fauna;
   - management issues; and
   - vegetation.

2. Walking Track Proforma:
   - track condition;
   - visitor related activity;
   - feral and domestic fauna;
   - track condition, cumulative impacts (human, natural or management related); and
   - vegetation condition.

3. Water Feature Proforma:
   - water quality;
   - visitor related activity;
   - factors related to human disturbance of fauna;
   - cumulative impacts (human, natural or management related); and
   - vegetation condition.

Procedure

The procedure is completed in four steps. Step 1 is to scan the area to gain a perspective of the extent and type of impact for each of the variables for each of the settings in the field (camp/picnic, walking track and water body). Step 2 is to conduct a more intensive walk through the area and allocate a score (1-5) to each of the variables. Step 3 consists of nominating a required action for each variable, and Step 4 is to add comments if necessary.

Example Using the Camp and Picnic Area Proforma

Step 1 and 2

Conduct a quick walk around the area to obtain an overall impression of the site. Using the Camp and Picnic Area Proforma, assess each variable on a scale of 1 to 5 where 1 is *no discernable change from the natural state or management intent*, and 5 in *major or severe impact* (e.g. unstable land slide).

Step 3

Score the type of action required.

Step 4

Make descriptive notes on any variable requiring immediate action, e.g. note if environmental or human risk, and/or note any item of interest not included on the proforma.

In making your assessment consider the number of items/structures, percentage of area effected, and type of damage. This will demonstrate the extent and type of impact.

Factors to Consider

- When assessing any of the variables use the forest as a reference point, e.g. is root exposure greater on the tread zone than in the surrounding forest?
- Need to separate out impacts due to hydrology and those associated with visitation.
- Consider each variable area under three broad areas, i.e. the impact of visitation and use on:
  - built (infrastructure);
  - natural environment; and
  - social environment/human risk.
- In assessing impacts consider where the impacts are concentrated, e.g. is litter or patch death greater near the start of a walking track, at the junction of two paths, or at creek crossings?

What are the Indicators Telling Management?

A description of the types of impacts associated with each variable and what they indicate to management is presented in Table 5 (page 32).

Table 5: Types of concerns associated with each variable and their indications to management.

Variable	Type of Concern (i.e. environmental, human risk, management)	What is being indicated?
Infrastructure damage (e.g. new vandalism, graffiti)	• Human risk, management	• Inappropriate visitor behaviour • Need for public education on impacts of actions • Need for greater ranger presence
Presence of mould and/or dirt on infrastructure (e.g. railings, tables, toilet facilities)	• Management	• Status of maintenance of infrastructure (i.e. maintenance, hygiene and aesthetics)
Vegetation damage (e.g. breakage, ringbarking, vandalism)	• Environmental risk • Human risk	• Inappropriate visitor behaviour • Need for public education on impacts of actions • Need for greater ranger presence • Need to fence off areas • Need for signs
Undesignated track(s) (e.g. to river, toilet, forest, camp sites)	• Environmental risk • Potential for erosion on steeper slopes	• Changes in visitor movements (i.e. visitors are not keeping to designated tracks) • Where new tracks may need to be made to service areas • Where old tracks may need upgrading • Need to fence off areas with re-occurring undesignated tracks
Fire scars on trees (human induced)	• Environmental risk • Human risk	• Visitors are building fires at the base of trees • May need to provide fire rings in close proximity
Litter (not sharp) (e.g. plastic bags, toilet paper, tissues)	• Environmental risk	• Inappropriate visitor behaviour • Need to provide rubbish bins with animal proof lids
Litter (sharp objects) (e.g. cans, bottles, broken glass, fencing wire, star pickets)	• Human risk	• Inappropriate visitor behaviour • Bins are required
Feeding wildlife	• Environmental risk	• Inappropriate visitor behaviour • Need for public education on impacts of actions
Birds/animals scavenging	• Environmental risk	• Inappropriate visitor behaviour • Need for public education on impacts of actions
Disturbing wildlife (e.g. throwing items, approaching)	• Environmental risk	• Inappropriate visitor behaviour • Need for public education on impacts of actions
Feral animals (i.e. presence/evidence)	• Environmental risk	• Environmental disturbance potential to distribute weeds and disease
Domestic animals (e.g. cats and dogs)	• Environmental risk	• Inappropriate visitor behaviour • Need for public education on impacts of actions • potential to distribute weeds and diseases and disturb native wildlife
Hazardous plants (e.g. stinging trees)	• Human risk	• Potential risk to visitors • Need for maintenance
Loose/slippery rocks/algae on rocks	• Human risk	• Potential risk to visitors • Need for signs and/or fencing
Potholes/bogs	• Human risk	• Need for maintenance
Bank erosion	• Environmental risk • Human risk	• Unstable geological area • Inappropriate visitor behaviour – social track

Variable	Type of Concern (i.e. environmental, human risk, management)	What is being indicated?
Storm damage	• Human risk	• Potential for human risk
Road impact (e.g. noise, dust)	• Environmental risk	• Need to buffer site from road disturbance
Water weeds (e.g. filamentous and blue-green algae)	• Environmental risk • Human risk	• Increased nutrient input may be external to site or related to visitors • Control measures required
Weeds	• Environmental risk	• Disturbance due to visitation, feral animals or other animal movements • Reduced potential for native seedling recruitment • Displacement of native vegetation • Control measures required
Midstorey and canopy patch death	• Environmental risk	• Decline in health of vegetation • May due to die-back or dry conditions or past cyclone damage or soil compaction and root damage due to management or visitation
Exposed roots	• Environmental risk	• Impact from visitation (i.e. trampling) • Increased hydrological impacts

Photographic Record at Sites

Method

1. Chose locations (nodes) within the site from which photographs can be taken on a repetitive basis, e.g. landscape features such as a large boulder, hill and/or permanent infrastructures such as pollution blocks, camping registration booths, shelters, designated car park, fork in a road.

   In choosing nodes consider areas that are sensitive to visitation and use, and those that give a good coverage of the site, e.g. picnic, camp and walking tracks.

2. Take four photographs at each node, e.g. north, east, south and west. Standardise the direction in which you take the photographs, e.g. clockwise. This will help you at a later date when you are sorting images.

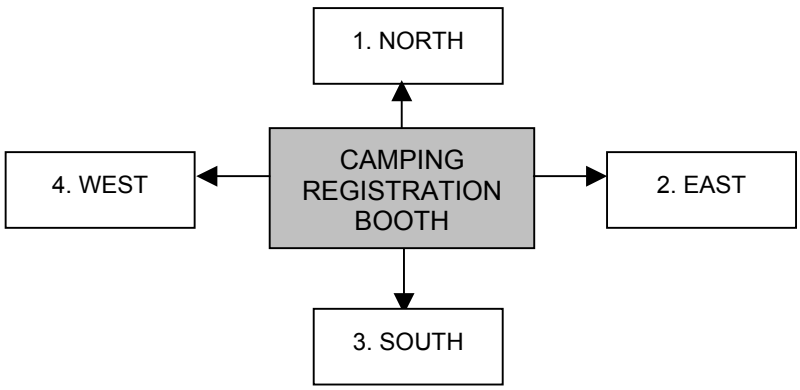


Figure 8: Standardised directions for photographic records.

3. Additionally, take a panoramic photo of the main use area, e.g. camp ground and/or picnic ground. Note the position the photograph is to be taken from.

Figure 9: Camp area at Murray Falls (taken from centre of road with booth in foreground).

Figure 10: Day use area at Murray Falls (taken from start of the first car park bay).

Table 6: Proforma for monitoring visitation and use at camp and picnic area (see Indicator Descriptions on pages 42-43).

Indicator	Rapid Assessment Proforma – CAMP AND PICNIC AREA					
Visitor Related Activity	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**	**Action Required**
[1]**Infrastructure damage** (e.g. vandalism, graffiti, breakages)						
[2]**Presence of mould and/or dirt on infrastructure** (e.g. railings, tables, toilet facilities)						
[3]**Vegetation damage** (e.g. breakage, ringbarking, vandalism (excluding fire), broken branches, bark stripping)						
[4]**Undesignated track(s)** (e.g. to river, toilet, forest, camp sites)						
[5]**Fire scars on trees** (e.g. human induced, due to camp fire at base of tree)						
[6]**Fire scars** (e.g. u*ndesignated* camp fires)						
[7]**Wood pile(s)** (e.g. *undesignated* clump of logs/branches)						
[8]**Foreign objects detrimental to fauna** (e.g. plastic bags, cig. Butts)						
[9]**Litter (not sharp)** (e.g. plastic bags, toilet paper, tissues)						
[10]**Litter (sharp objects)** (e.g. cans, bottles, broken glass, fencing wire, star pickets (describe below)						
Factors Related to Human Disturbance of Fauna	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**	**Action Required**
[11]**Feeding wildlife**						
[12]**Birds/Animals Scavenging**						
[13]**Disturbing Wildlife** (e.g. throwing items, approaching)						
[14]**Feral animals** (e.g. pigs, cats, cane toads) Please note presence/evidence.						
[15]**Domestic animals** (e.g. cats and dogs)						

Indicator	Rapid Assessment Proforma – CAMP AND PICNIC AREA					
Management Issues	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**	**Action Required**
[16]**Hazardous plants** (e.g. stinging trees, calamus)						
[17]**Potholes/Bogs**						
[18]**Mineral soil exposure** (e.g. bare ground excluding carpark and road and natural unvegetated granite area)						
[19]**Gully erosion**						
[20]**Storm damage**						
[21]**Road impact** (e.g. noise, dust)						
Vegetation	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**	**Action Required**
[22]**Weeds**						
[23]**Midstorey and canopy patch death** (e.g. vegetation on edge of camp/picnic area)						
[24]**Exposed roots** (e.g. along edge of forest, tracks and roads and picnic/camp areas)						

Table 7: Proforma for monitoring visitation and use along a walking track (see Indicator Descriptions on pages 42-43).

Indicator (Track Condition)	**Rapid Assessment Proforma - WALKING TRACK AREA**					
Visitor Related Activity	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**	**Action Required**
[1]**Undesignated track(s)** (e.g. from main track to river, camp sites or as short cuts between main track)						
[2]**Foreign objects detrimental to fauna** (e.g. plastic bags, cig. butts)						
[3]**Litter (not sharp)** (e.g. toilet paper, tissues, cig butts)						
[4]**Litter (sharp objects)** (e.g. cans, bottles, broken glass, fencing wire, star pickets on track or edge)						
[5]**New fire scars - edge** (human induced)						
Feral and Domestic Fauna	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**	**Action Required**
[6]**Feral animals** (e.g. pigs, cats, dogs, cane toads)						
[7]**Domestic animals** (e.g. cats and dogs)						
Track Condition – Cumulative Impact (human, natural or management related)	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**	**Action Required**
[8]**Infrastructure damage** (e.g. vandalism, graffiti, breakages)						
[9]**Vegetation damage** (e.g. breakage, ringbarking, vandalism, broken branches, bark stripping)						
[10]**Track Widening**						
[11]**Hazardous plants - edge or overhanging** (e.g. stinging trees, calamus)						
[12]**Potholes/Bogs**						
[13]**Mineral soil exposure** (e.g. bare ground excluding unvegetated granite areas)						
[14]**Gully erosion** (e.g. across or along track)						

Indicator (Track Condition)	**Rapid Assessment Proforma - WALKING TRACK AREA**					
[15]**Debris blocking culvert/drains**						
[16]**Loose/slippery stones**						
[17]**Track structure** (e.g. rotten tread, edge eroded)						
[18]**Storm damage** (e.g. tree fall, flooding)						
Vegetation	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**	**Action Required**
[19]**Weeds**						
[20]**Exposed roots** (excluding trees such as figs with above ground roots unless the soil is eroded around them)						
[21]**Tree death**						
[22]**Midstorey and canopy patch death**						
[23]**Bracket fungi on live trees**						

Table 8: Proforma for monitoring visitation and use at a freshwater feature (see Indicator Descriptions on pages 42-43).

Indicator	Rapid Assessment Proforma - FRESH WATER FEATURE					
Water Quality	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**	**Action Required**
[1]**Surface film**						
[2]**Water clarity/ settling**						
[3]**Water odour**						
Visitor Related Activity	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**	**Action Required**
[4]**Infrastructure damage** (e.g. vandalism, graffiti on signs, railings, breakages)						
[5]**Presence of mould and/or dirt on infrastructure** (e.g. railings, tables, signs)						
[6]**Vegetation damage** (e.g. breakage, ringbarking, vandalism, broken branches, bark stripping)						
[7]**Undesignated track(s)** (e.g. to water body or through forest)						
[8]**Fire scars on trees** (human induced, due to campfire at base of tree)						
[9]**Fire scars** (*undesignated* camp fires)						
[10]**Foreign objects detrimental to fauna** (e.g. plastic bags, cig. butts)						
[11]**Litter (not sharp)** (e.g. plastic bags, toilet paper, tissues, cig butts)						
[12]**Litter (sharp objects)** (e.g. cans, bottles, broken glass, fencing wire, star pickets (describe below)						

Indicator	Rapid Assessment Proforma - FRESH WATER FEATURE					
Factors Related to Human Disturbance of Fauna	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**	**Action Required**
[13]**Feeding wildlife**						
[14]**Birds/animals scavenging**						
[15]**Disturbing wildlife** (e.g. throwing items, approaching)						
[16]**Feral animals** (e.g. pigs, cats, cane toads presence/evidence						
[17]**Domestic animals** (e.g. cats and dogs)						
Cumulative Impact (human, natural or management related)	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**	**Action Required**
[18]**Hazardous plants** (e.g. stinging trees, calamus)						
[19]**Loose/slippery rocks/ algae on rocks**						
[20]**Potholes/Bogs**						
[21] **Bank Erosion**						
[22]**Storm Damage**						
[23]**Road impact** (e.g. noise, dust)						
Vegetation	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**	**Action Required**
[24]**Water weeds** (e.g. filamentous and blue-green algae)						
[25]**Weeds on bank**						
[26]**Midstorey and canopy patch death**						
[27]**Exposed roots** that are not natural along edge of bank and entrance point to water body						

ADVANCED LAND MANAGER MONITORING (OPTIONAL)

The advanced-ranger monitoring procedure is a further development of the basic land manager monitoring (Tables 6-8). It is designed to enable the user to produce a condition score for a site based on the condition of the built environment (infrastructure), natural condition and human risk.

Process in Completing Assessment of Conditions Scores for Sites

This is completed in four steps. The first step is to assess the extent and type of impact for each of the variables for each of the settings (camp/picnic, walking track and water body), in the field. The second is to use this data to allocate a score for each variable using the sheet that identifies impact level and score. The third is to apply weightings and the fourth is to determine a condition score for the site.

Camp and Picnic Area

Step 1

Conduct a quick walk around the area to obtain an overall impression of the site. Using the Camp and Picnic Area Record Sheet (Table 10) assess each variable on the form. The form is designed so you can record the number of items/structures, percentage of area affected, and type of damage. This will demonstrate the extent and type of impact.

Step 2

Either in the field or in the office, allocate a score to each variable using the Identification of Impact Level Sheet (Tables 11-13) to interpret the extent and type of impact you recorded. At the end of this step you will have determined a score of 1 to 5 for each variable.

Step 3

Multiply the score by each of the three weighting factors (Table 9) to produce three new scores, that is one for the infrastructure, natural environment and human risk respectively.

Step 4

Sum the scores for the infrastructure, natural environment and human risk separately to produce an overall condition score for the setting. You can also produce scores for each of these components (infrastructure, natural environment and human risk) for each section within the form.

Repeat this procedure for the walking track and water body forms.

Comments on the Quantitative Values Attributed to Each Level of an Indicator

The quantitative measures for each level of each variable (Tables 11-13) were developed through a literature search, discussions with researchers, responses form a panel of researchers, rangers, Queensland Parks and Wildlife and Wet Tropics Management Authority staff, and a workshop conducted with fourth year Environmental Management students from The University of Queensland (UQ). Prior to the workshop, UQ students were given the proformas to trial in the field. They were asked to assess each proforma separately. Their instructions were to quickly scan the area and then begin assessing each variable on a scale of 1 (not obvious) to 5 (very obvious). Once they had allocated a score for each variable they were then asked to describe it in quantitative terms. For example the

number of items per set distance, percentage cover, percentage contribution, length, width, depth etc. They were than asked to give quantitative values for the rest of the scale.

Where possible a range of quantitative values for each indicator is given. These are based on number of items affected, percentage of cover of area or percentage of items affected. In some cases it is necessary to consider number of small or number of large items affected, e.g. vegetation damage may be concentrated in one large area or scattered in several small areas over the site (see below). A qualitative measure is also included for most variables.

Indicator Descriptions

[1]**Infrastructure damage –** Assessed on number of items affected and/or percentage of items affected.

[2]**Presence of mould and/or dirt on infrastructure –** Assessed on number of items; percentage of items with mould or dirt; intensity of dirt, i.e. surface to thick layer.

[3]**Vegetation damage –** Assessed on number of trees with broken branches or bark stripped; number of broken shrubs; number of small or large patches of damaged shrubs/seedlings; and type of damage. Small patch ~ 0.5 cubic metres; large patch > 0.5 cubic metres. Bark stripping was noted as a problem in some parks where dry kindling was not available for campfires.

[4]**Undesignated track(s) –** Consider the length and width of track. It may refer to number of tracks per one hundred metres of edge of forest, whether camping/visiting or walking.

[5]**Fire scars on trees –** Number of scars of fifty-centimetre diameter per ten cubic metres, or number scattered through area.

[7]**Wood pile(s) –** Number of small and large woodpiles.

[8]**Foreign objects detrimental to fauna –** Number of items scattered throughout site.

[9]**Litter (not sharp) –** Number of items.

[10]**Litter (sharp objects) –** Identify number of objects in high or medium use area.

[11]**Hazardous plants –** Number of stinging trees on edge of cleared area, or number of clumps of calamus encroaching on area.

[12]**Potholes/bogs –** Number of potholes, and size (depth and width); percentage of area covered in bog.

[13]**Mineral soil exposure –** Bare ground excluding carpark and road and natural unvegetated granite area. In areas where the management intent is to maintain lawn or grass, mineral soil exposure is assessed as number of small or large patches in area, percentage of area exposed.

[14]**Gully erosion –** Assessed as number, depth, length.

[15]**Storm damage –** Assessed on size of debris on ground, i.e. leaves, twigs, small branches, large branches or trees.

[16]**Road impact –** For example, noise or dust (assessed on extent of dust cover and intensity of noise).

[17]**Weeds –** Assessed on number of small clumps/patches and percentage of vegetation on edge of area.

[18]**Midstorey and canopy patch death –** Note canopy openness that is <u>not</u> caused by lightning or storms or deciduous trees, is not natural in a healthy rainforest. This variable is assessed as number of small and large patches and/or number of patches coalescing. Obvious reasons for patch death should be noted such as extensive dry weather, and where possible species affected (*Cardwellia sublimis* in particular is very sensitive to die-back).

[19]**Exposed roots –** Assessed by number of trees, number of trees in high use area. Note this does not include trees that naturally have roots running over the surface unless the soil is eroded away from under them.

[20]**Feeding wildlife –** Number of people involved or number of incidents observed or evidence of feeding, i.e. bread scattered for birds.

[21]**Birds/animals scavenging –** Number of birds or animals and their behaviour, i.e. nervous, lingering, approaching and staying near shelters.

[22]**Disturbing wildlife –** For example, throwing items, number of incidents involving approaching, number of people/groups involved.

[23]**Feral animals –** For example, pigs, cats, cane toads. Number of animals sighted, number of piles of scat, number of diggings. Caution: need to check for bandicoots and scrub turkeys in the area if numbers of diggings are being used in analysis. Also, need to note on what basis this variable was scored, i.e. animals sighted, scat piles or diggings).

[24]**Domestic animals –** For example, cats and dogs – number of animals.

Weightings

Process for Determining a Weighting for Each Variable

A workshop was conducted at James Cook University, with the twelve University of Queensland students who participated in the standardisation of the levels of the variables.

The importance of each variable on the overall condition of the site was assessed under three headings:

a) natural environment;
b) built environment; and
c) human risk.

As the importance of each variable in the natural environment, built environment and human risk varies depending on the setting, these were assessed separately for each of the proformas, e.g. camp/picnic, walking track and water feature. Students were asked to discuss the relationship and importance of each variable in the natural environment, built environment and in human risk prior to scoring each variable on a scale of 0-9. Weightings developed from this workshop are presented in Table 9.

Comments Considered in Determination of Weightings of Each Variable

Camp and Picnic Area

- The lawn is considered part of the built environment.
- If there is no contribution by the variable then the weighting is 0 (zero).

The weightings developed here are considered to be at a very early stage of development and need a lot more workshops before they are implemented.

Table 9: Weightings for Camp and Picnic Area Proforma determined by Environmental Management students of The University of Queensland (see Indicator Descriptions on pages 42-43).

Variable	Natural Environment	Built Environment	Human Risk
Visitor Related Activity			
[1]**Infrastructure damage** (e.g. new vandalism, graffiti)	0	7.5	8
[2]**Presence of mould and/or dirt on infrastructure** (e.g. railings, tables, toilet facilities)	0	5.5	3.5
[3]**Vegetation damage** (e.g. breakage, ringbarking, vandalism)	8.5	1	6
[4]**Undesignated track(s)** (e.g. to river, toilet, forest, camp sites)	7	1	6
[5]**Fire scars on trees** (human induced)	5	0	2
[6]**Fire scars** (*undesignated* camp fires)	2	2	3
[7]**Wood pile(s)** (*undesignated* clump of logs/branches)	1	1	3
[8]**Foreign objects detrimental to fauna** (e.g. plastic bags, cig. butts)	8	0 structure 8 aesthetics	0
[9]**Litter (not sharp)** (e.g. plastic bags, toilet paper, tissues)	5.5	0 structure 8 aesthetics	0
[10]**Litter (sharp objects)** (e.g. cans, bottles, broken glass, fencing wire, star pickets) (please describe below)	7.5 chemical component	0 structure 8 aesthetics	8
Cumulative Impacts (human, natural or management basis)			
[11]**Hazardous plants** (e.g. stinging trees)	0	0	3
[12]**Potholes/bogs**	3	5.5	2.5
[13]**Mineral soil exposure** (bare ground excluding car park and road)	4	1	0
[14]**Gully erosion**	4.5	1	0
[15]**Storm damage**	0	7	7
[16]**Road impact** (e.g. noise, dust)	6	1	0
Vegetation			
[17]**Weeds**	8	0.5	0
[18]**Midstorey and canopy patch death**	6	0	0
[19]**Exposed roots**	5	0	1
Factors Related to Human Disturbance of Fauna			
[20]**Feeding wildlife**	6.5	0	3
[21]**Birds/animals scavenging**	6.5	0	3
[22]**Disturbing wildlife** (e.g. throwing items, approaching)	6.5	0	0.5
[23]**Feral animals** (e.g. pigs, cats, cane toads) Please note presence/evidence	7	0	1
[24]**Domestic animals** (e.g. cats and dogs)	5	0	1

Table 10: Data entry form for use in assessing level of impact associated with each variable. This form is also suitable for walking tracks and freshwater features with the addition of a few variables not required at a camp and picnic area.

CAMP AND PICNIC RECORD SHEET											
Indicator	**Indicator Description**	**Number of Items**	**Percentage of Items**	**Percentage of Effect on Structure**	**Type of Damage (e.g. pain, surface scratches, wood carved or broken)**	**Comments (e.g. new damage)**	**Action**	**Score**	**Built Environment**	**Natural Environment**	**Human Risk**
Visitor Related Activity											
1	Infrastructure damage (e.g. new vandalism, graffiti)										
2	Presence of mould and/or dirt on infrastructure (e.g. railings, tables, toilet facilities)										
3	Vegetation damage (e.g. breakage, ringbarking, vandalism)										
4	Undesignated track(s) (e.g. to river, toilet, forest, camp sites)										
5	Fire scars on trees human induced										
6	Fire scars (undesignated camp fires)										
7	Wood pile(s) undesignated clump of logs/branches)										
8	Foreign objects detrimental to fauna (e.g. plastic bags, cig. butts)										
9	Litter (not sharp) (e.g. plastic bags, toilet paper, tissues)										

CAMP AND PICNIC RECORD SHEET											
Indicator	**Indicator Description**	**Number of Items**	**Percentage of Items**	**Percentage of Effect on Structure**	**Type of Damage (e.g. pain, surface scratches, wood carved or broken)**	**Comments (e.g. new damage)**	**Action**	**Score**	**Built Environment**	**Natural Environment**	**Human Risk**
10	Litter (sharp objects) (e.g. cans, bottles, broken glass, fencing wire, star pickets) (please describe below)										
Cumulative Impacts (human, natural or management basis)											
11	Hazardous plants (e.g. stinging trees, calamus)										
12	Potholes/bogs										
13	Mineral soil exposure (bare ground excluding carpark and road and natural unvegetated granite area)										
14	Gully erosion										
15	Storm damage										
16	Road impact (e.g. noise, dust)										
Vegetation											
17	Weeds										
18	Midstorey and canopy patch death (vegetation on edge of camp/picnic)										
19	Exposed roots along edge of forest, tracks and roads and picnic/camp areas										

CAMP AND PICNIC RECORD SHEET											
Indicator	**Indicator Description**	**Number of Items**	**Percentage of Items**	**Percentage of Effect on Structure**	**Type of Damage (e.g. pain, surface scratches, wood carved or broken)**	**Comments (e.g. new damage)**	**Action**	**Score**	**Built Environment**	**Natural Environment**	**Human Risk**
Factors Related to Human Disturbance of Fauna											
20	Feeding wildlife										
21	Birds/animals scavenging										
22	Disturbing wildlife (e.g. throwing items, approaching)										
23	Feral animals (e.g. pigs, cats, cane toads) (please note presence/evidence)										
24	Domestic animals (e.g. cats and dogs)										

Table 11: Identification of Level of Impact – Camp and Picnic Area (see Indicator Descriptions on pages 42-43).

INDICATOR: Visitor Related Activity	1 Not Discernable	2 Minor Change	3 Moderate Change	4 High Change	5 Major/Severe Change
[1]**Infrastructure damage** (e.g. vandalism, graffiti, breakages)	none	Either/Or • 1 item • <10% of item Minor damage (does not affect use)	Either/Or • 2-3 items • 10-20% items Small chips and carving	Either/Or • 4-5 items • 20-30% items Large/deep cuts on items, potential hazard	Either/Or • >5 items • >30% items Sharp edges large section missing major structural damage
[2]**Presence of mould and/or dirt on infrastructure** (e.g. railings, tables, toilet facilities)	none	Either/Or • 1 item • <10% items Surface dust and dirt	Either/Or • 2-3 items • 10-20% items Thin layer mould, grease, dirt	Either/Or • 4-5 items • 20-30% items Considerable layer mould, grease, dirt	Either/Or • >5 items • >30% items Thick grease, mould, or dirt, on infrastructure
[3]**Vegetation damage** (e.g. breakage, ringbarking, vandalism (excluding fire), broken branches, bark stripping)	none	Either/Or • 1 tree • 1-3 (several) small plants • 1 small patch seedlings/ shrubs	Either/Or • 2-3 trees • 4-8 small plants • 2-3 scattered small patches or 1 large patch	Either/Or • 4-5 trees • 9-12 small shrubs • 4-5 patches or 2 large patches	Either/Or • >5 trees • 1 tree ringbarked • >12 shrubs • at least 5 large patches Most of vegetation fringing area damaged
[4]**Undesignated track(s)** (e.g. to river, toilet, forest, camp sites)	none	Either/Or • 1-2 narrow tracks (<0.5m wide) / 100m edge partially vegetated • 1 track (≥ 0.5m wide) / 100m edge partially vegetated	Either/Or • 2-3 narrow tracks (<0.5m wide) / 100m edge • 1 track (≥ 0.5m wide) / 200m edge	Either/Or • 4-5 narrow tracks (< 0.5m wide) / 100m edge • 2-3 (≥ 0.5m wide) / 200m	Either/Or • ≥ 5 narrow tracks / 100m edge • ≥ 0.5m wide tracks/ 200m edge Numerous narrow and wide tracks
[5]**Fire scars on trees** (human induced, due to camp fire at base of tree)	none	Either/Or • At least 1 but <2 per site • <1% trees	Either/Or • 2-4 trees • < 10% trees	Either/Or • 5-10 trees or more than 3 trees in one scan area; • 10-30 % trees	Either/Or • >10 trees in survey area; • > 30% trees

[6]**Fire scars** (*undesignated* camp fires)	none	• 1 scar up to 50 cm dia/10m^3	• 2-3 scars/10 m^3	Either/Or • 4-5 /10 m^3 • > 3 per one scan area	Either/Or • >5 scars /10m^3 Scars scattered through out area
[7]**Wood pile(s)** (*undesignated* clump of logs/branches)	none	• 1 small pile	Either/Or • 2-3 small piles • 1 large pile	Either/Or • 4-5 small piles • 2-3 large piles	Either/Or • 5 small piles or • > 3 large piles
[8]**Foreign objects detrimental to fauna** (e.g. plastic bags, cig. butts)	none	• 1-3 objects	• 4-6 objects	• 7-10 objects	• >10 objects
[9]**Litter (not sharp)** (e.g. plastic bags, toilet paper, tissues)	none	• 1-3 objects	• 4-6 objects	• 7-10 objects	• > 10 objects
[10]**Litter (sharp objects)** (e.g. cans, bottles, broken glass, fencing wire, star pickets) (please describe below)	none	• 1 object	Either/Or • 1 object in high use area • 2-3 objects in med. use area	Either/Or • 2 objects in high use area • 4-5 objects in med. use area	Either/Or • >2 objects in high use area and/or • >5 objects in med. use area
INDICATOR: Factors Related to Human Disturbance of Fauna	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**
[11]**Feeding wildlife**	none	Either/Or • 1 person involved • 1 incidents	Either/Or • 2-3 people involved • 2-3 incidents	Either/Or • 4-5 people • 2 groups (1-3 people) • 4-5 incidents	Either/Or • >5people • >2 groups • More than 5 incidents
[12]**Birds/animals scavenging**	none	• 1 bird or animal intermittent/nervous approach	• 1 or more birds or animals lingering near picnic/camp eating areas	• birds or animals approaching eating areas	• birds and animals approaching people and eating areas, tents; rummaging through rubbish
[13]**Disturbing wildlife** (e.g. throwing items, approaching)	none	Either/Or • 1 person involved • 1 incidents	Either/Or • 2-3 people involved • 2-3 incidents	Either/Or • 4-5 people • 2 groups (1-3 people) • 4-5 incidents	Either/Or • >5people • >2 groups More than 5 incidents

[14]**Feral animals** (e.g. pigs, cats, cane toads) Please note presence/evidence	none	Either/Or • 1-2 feral animals • 1 pile of scat • 1-2 diggings	Either/Or • 3-5 feral animals • 2-5 piles of scat • 3-5 diggings	Either/Or • 6-9 feral animals • 6-10 piles of scat • 6-10 diggings	Either/Or • 10 or more animals • >10 piles of scat Diggings around edge and within camp/picnic area
[15]**Domestic animals** (e.g. cats and dogs)	none	• 1 animal remains in vehicle	• 1 animal in area on leash	• 1 animal unsupervised/loose	• More than 1 animal loose
INDICATOR: Management Issues	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**
[16]**Hazardous plants** (e.g. stinging trees, calamus)	none	Either/Or • 1 clump calamus encroaching on cleared area	Either/Or • 2 clumps calamus encroaching on cleared area	Either/Or • 3 clumps calamus encroaching on cleared area • 1 large patch on edge	Either/Or • ≥1 stinging trees or 4 clumps calamus encroaching on cleared area • 2 large patches on edge
[17]**Potholes/bogs**	none	Either/Or • 1-3 small (5cm diameter and <2cm deep) potholes • <10% area potholes or bog	Either/Or • 2-6 small potholes • 2 large (10 cm dia. 3-5 cm deep) • 2 large boggy areas • 10-20% area	Either/Or • 7-10 small potholes • 3 large potholes • 3 large boggy areas or • 20-30% area	Either/Or • 10 small potholes • > 3 large potholes • >30% area boggy
[18]**Mineral soil exposure** (bare ground excluding carpark and road and natural unvegetated granite area)	none	Either/Or • 1-2 small patches 10 cm diameter • <10% of area bare ground	Either/Or • 3-5 small patches • 10-20% of area • 1 large patch • isolated small and large bare patch around high use area	Either/Or • 6-8 small patches • >1 large patches • 20-30% of area bare ground	Either/Or • > 8 patches • >30% bare soil • wide areas (>1m) around infrastructure bare soil
[19]**Gully erosion**	none	Either/Or • 1-2 isolated gullies less than 3cm deep • present but very limited gully erosion	• 1-2 gullies 5 cm deep and 1.5 m long	• 1-2 gullies 5 cm deep and > 1.5 m long	• > 2 gullies > 5 cm deep

[20]**Storm damage**	none	• twigs and leaves down	• small broken branches, scattered debris (twigs and leaves)	Either/Or • large broken branches • some infrastructure damage	Either/Or • fallen trees • major infrastructure damage
[21]**Road impact** (e.g. noise, dust)	none	• some muffled traffic noise	• noticeable dust and/or traffic noise	• excessive dust and traffic noise	• excessive dust causing plant death and/or deafening traffic noise
INDICATOR: Vegetation	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**
[22]**Weeds**	none	Either/Or • 1-2 small clumps • weeds < 10% of edge vegetation	Either/Or • 3-5 clumps • weeds 10-20% of edge vegetation	Either/Or • 5 large patches • weeds 20-30% of edge vegetation	Either/Or • spread over most of area • weeds >30% of edge vegetation
[23]**Midstorey and canopy patch death** (vegetation on edge of camp/picnic site)	none	• 1-2 open patches	Either/Or • 3-5 open patches • 2 patches coalescing	Either/Or • 6-10 open patches • >2 patches coalescing	• > 10 patches, with several large patches
[24]**Exposed roots** along edge of forest, tracks and roads and picnic/camp area	none	• 1-3 trees	• 4-6 trees, • at least 1 tree in high use area	Either/Or • 7-10 trees • 2-5 trees in high use area	Either/Or • 10 trees • > 5 trees in high use area

Table 12: Identification of Level of Impact – Walking Tracks (see Indicator Descriptions on pages 42-43).

INDICATOR: Track Condition Visitor Related Activity	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**
[1]**Undesignated track(s)** (e.g. from main track to river, camp sites or as short cuts between main track)	none	Either/Or • 1-2 narrow (<0.5m wide) tracks • 1 track (≥ 1 m wide)	Either/Or • 2-3 narrow (<0.5m) tracks • 1 track (≥ 0.5m wide)	Either/Or • 4-5 narrow tracks 2-3 • 2 tracks (≥ 0.5m wide)	Either/Or • ≥ 5 narrow tracks • ≥ 0.5m wide tracks • Numerous narrow and wide tracks
[2]**Foreign objects detrimental to fauna** (e.g. plastic bags, cig. butts)	none	• 1-3 objects	• 4-6 objects	• 7-10 objects	• 10 objects
[3]**Litter: not sharp** (e.g. toilet paper, tissues, cig. butts)	none	• 1-3 objects	• 4-6 objects	• 7-10 objects	• > 10 objects
[4]**Litter (sharp objects)** (e.g. cans, bottles, broken glass, fencing wire, star pickets on track or edge	none	• 1 object	• 2-3 objects	• 4-5 objects	• >5 objects
[5]**New fire scars - edge** (human induced)	none	Either/Or • At least 1 but <2 per 1 km • <1% trees	Either/Or • 2-4 trees • < 10% trees	Either/Or • 5-10 trees or more than 3 trees in one scan area • 10-30 % trees	Either/Or • >10 trees in survey area • > 30% trees
INDICATOR: Feral and Domestic Fauna	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**
[6]**Feral animals** (e.g. pigs, cats, dogs, cane toads)	none	Either/Or • 1-2 feral animals • 1 pile of scat • 1-2 diggings	Either/Or • 3-5 feral animals • 2-5 piles of scat • 3-5 diggings	Either/Or • 6-9 feral animals • 6-10 piles of scat • 6-10 patches of diggings	Either/Or • 10 or more animals • >10 piles of scat • extensive diggings along edge
[7]**Domestic animals** (e.g cats and dogs)	none	• 1 animal remains in vehicle	• 1 animal in area on leash	• 1 animal unsupervised/loose	• More than 1 animal loose
INDICATOR: Track Condition Cumulative Impact (human, natural or management related)	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**

[8]**Infrastructure damage** (e.g. vandalism, graffiti, breakages)	none	Either/Or • 1 item • <10% items dirty minor damage does not affect use	Either/Or • 2-3 items • 10-20% items small chips and carving	Either/Or • 4 items • 20-30% items large/deep cuts on items, potential hazard	Either/Or • ≥5 items • >30% items railings and signs broken, sections of board walk broken/missing major structural damage
[9]**Vegetation damage** (e.g. breakage, ringbarking, vandalism, broken branches, bark stripping)	none	Either/Or • 1 tree • 1-3 (several) small plants trampled • 1 small patch seedlings/shrubs trampled or uprooted	Either/Or • 2-3 trees 4-8 small plants trampled • 2-3 scattered small patches or 1 large patch trampled and/or uprooted	Either/Or • 4-5 trees • 9-12 small shrubs • 4-5 small patches or 2 large patches vandalised	Either/Or • >5 trees • ≥1 tree ringbarked • >12 shrubs • at least 5 large patches vandalised • most of vegetation fringing track damaged
[10]**Track Widening**	Not apparent	• minimal, 1-2 step off points up to 0.25 m	• moderate, 3-5 (several) step off points up to 0.25 m	Either/Or • severe, numerous (>5) step off points 0.25 - 0.5m, • bare area around 1 large tree e.g. fig	• extreme, 1 long section of widening either side of track
[11]**Hazardous plants - edge or overhanging** (e.g. stinging trees, calamus)	none	Either/Or • 1 clump calamus	Either/Or • 2 clumps calamus encroaching on cleared area	Either/Or • 3 clumps calamus encroaching on cleared area	Either/Or • 1-2 stinging trees/100 m • 3 clumps calamus encroaching on cleared area • fallen tree across track
[12]**Potholes/bogs**	none	Either/Or • 1-3 small (5cm diameter and <2cm deep) potholes • <10% area potholes or bog	Either/Or • 2-6 small potholes • 2 large (10 cm dia. 3-5 cm deep) • 2 large boggy areas10-20% area	Either/Or • 7-10 small potholes • 3 large potholes • 3 large boggy areas 20-30% area	Either/Or • 10 small potholes • > 3 large potholes >30% area boggy
[13]**Mineral soil exposure** (bare ground excluding unvegetated granite areas; doesn't apply to boardwalks)	none	Either/Or • 1-3 small patches (10 - 15 cm diameter) • <10% of track bare ground	Either/Or • 4-6 small patches • 10-20% of track • 1 large patch	Either/Or • 7-9 small patches • >1 large patches • 20-30% of track bare soil	Either/Or • 10̰ patches • >30% of track bare soil

[14]**Gully erosion -** across or along track	none	• 1-3 gullies less than 3cm deep encroaching on track	• 4-7 gullies >3 cm deep	Either/Or • 8-12 gullies >3 cm deep • gullies > 1m long bisecting track longitudinally	Either/Or • > 12 gullies > 3 cm • deep gullies > 1.5 m bisecting track
[15]**Debris blocking culvert/drains**	none	• minimal litter in culvert or drain(s)	Either/Or • litter to 5 cm deep • quarter of drain (s) blocked	Either/Or • litter to 15 cm deep • half of drain (s) blocked	Either/Or • litter > 15 cm deep • drain (s) 3/4 to fully blocked
[16]**Loose/slippery stones**	not apparent	• 1-2 patches of loose stones but not slippery	Either/Or • 3-5 patches of loose stones • 1-3 patches of slippery stones	• 5-8 patches of loose and slippery stones	• >8 patches of loose and slippery stones
[17]**Track structure** (e.g. rotten tread, edge eroded)	not apparent	• minimal edge erosion and no rotten tread	• Moderate edge erosion (10% of track), no rotten tread	• Severe edge erosion (10-20% of track), some rotten tread on edge	• rotten tread on edge and centre and rotten railing and/or >20% edge eroded
[18]**Storm damage** (e.g. tree fall, flooding)	none	• fresh twigs and leaves covering most of track	• small broken branches, and twigs and leaves on most of track	Either/Or • large broken branches across track • some infrastructure damage	Either/Or • fallen trees across track • major infrastructure damage
INDICATOR: Vegetation Condition	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**
[19]**Weeds**	none	Either/Or • 1-2 small clumps bordering track • weeds < 10% of edge vegetation	Either/Or • 3-5 clumps bordering track • weeds 10-20% of edge vegetation	Either/Or • 5 large patches • weeds 20-30% of edge vegetation	• >30% of edge vegetation
[20]**Exposed roots** excluding trees such as figs with above ground roots unless the soil is eroded around them	none	• 1 tree/100 m	• 2-3 trees /100m and saplings	• 4-6 trees/100 m and saplings	• >6 trees /100 m and saplings
[21]**Tree death**	0-1 trees	• 2-3 trees	• 4-6 trees	• 7-9 trees	• ≥ 10 trees

[22]**Midstorey and canopy patch death**	none	• 1-2 open patches	Either/Or • 3-5 open patches • 2 patches coalescing	Either/Or • 6-10 open patches • >2 patches coalescing	• > 10 patches, with several large patches
[23]**Bracket fungi on live trees**	none	• 1-2 trees	• 3-5 trees	• 6-9 trees	• ≥ 10 trees

Table 13: Identification of Level of Impact – Freshwater Feature (see Indicator Descriptions on pages 42-43).

INDICATORS Water Quality	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**
[1]**Surface film**	No surface film	Slight surface film at access point	Surface film around margins	Surface film throughout most of water body	Surface film throughout whole water body (e.g. oily)
[2]**Water clarity/settling**	Clear	Some suspended matter, slightly cloudy	Moderately cloudy	Highly cloudy	Very milky/opaque
[3]**Water odour**	No odour	Mild objectionable odour	Moderately objectionable odour	Strong putrid smell	Very strong objectionable odour or strong musky smell
INDICATORS Visitor Related Activity	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**
[4]**Infrastructure damage** (e.g. vandalism, graffiti on signs, railings, breakages)	none	Either/Or • 1 item • <10% items • minor damage, scratches, does not affect use	Either/Or • 2-3 items • 10-20% items • small chips and carving	Either/Or • 4 items • 20-30% items • large/deep cuts on items, potential hazard	Either/Or • ≥5 items • >30% items • sharp edges large section missing major structural damage
[5]**Presence of mould and/or dirt on infrastructure** (e.g. railings, tables, signs)	none	Either/Or • 1 item • <10% items • surface dust and dirt	Either/Or • 2-3 items • 10-20% items • thin layer mould, grease, dirt on infrastructure	Either/Or • 4-5 items • 20-30% items • extensive thick layer mould, grease, dirt	Either/Or • >5 items • >30% items • thick grease, mould, dirt, layer of leaves
[6]**Vegetation damage** (eg. breakage, ringbarking, vandalism, broken branches, bark stripping)	none	Either/Or • 1 tree • 1-5 (several) small plants damaged • 1 small patch seedlings/shrubs damaged	Either/Or • 2-3 trees • 6-8 small plants • 2-3 scattered small patches or 1 large patch	Either/Or • 4-5 trees • 9-12 small shrubs • 4-5 small patches • 2 large patches	Either/Or • >5 trees • ≥1 tree ringbarked • >12 shrubs damaged • at least 5 large patches • most of vegetation fringing area damaged

[7]**Undesignated track(s)** (e.g. to water body or through forest)	none	Either/Or • 1-2 narrow (<0.5m wide) tracks/ 100 m edge • 1 (≥ 0.5m wide) / 100m edge	Either/Or • 2-3 narrow (<0.5m) tracks/ 100m edge • 1 track bare soil (≥ 0.5m wide / 100m	Either/Or • 4-5 narrow tracks/ 100 m edge • 2-3 bare soil (≥ 0.5m wide) / 100m	Either/Or • ≥ 5 narrow tracks/ 100 m edge • ≥ 0.5m wide tracks/ 100m edge • Numerous narrow and wide tracks
[8]**Fire scars on trees** (human induced, due to camp fire at base of tree)	none	Either/Or • At least 1 but <2 per 100 m bank • <1% trees	Either/Or • 2-4 trees per 100 m bank • < 10% trees	Either/Or • 5-10 trees per 100 m bank, • 10-30% trees	Either/Or • >10 trees per 100 m bank, • >30% trees
[9]**Fire scars** (*undesignated* camp fires)	none	• 1 scar up to 50 cm dia/100 m bank	• 2-3 scars/100 m bank	Either/Or • 4-5 /100 m bank • > 3 per one scan area	Either/Or • >5 scars /100 m bank • scars scattered along bank
[10]**Foreign objects detrimental to fauna** (e.g. plastic bags, cig. butts)	none	• 1-3 objects/ 100 m bank	• 4-6 objects / 100 m bank	• 7-10 objects • / 100 m bank	• 10 objects/ 100 m bank
[11]**Litter (not sharp)** (e.g. plastic bags, toilet paper, tissues, cig. butts)	none	• 1-3 objects/ 100 m bank	• 4-6 objects/ 100 m bank	• 7-10 objects/ 100 m bank	• 10 objects/ 100 m bank
[12]**Litter (sharp objects)** (e.g. cans, bottles, broken glass, fencing wire, star pickets)	none	• 1 object	Either/Or • 1 object in high use area • 2-3 objects in low. use area	Either/Or • 2 objects in high use area • 4-5 objects in low use area	Either/Or • >2 objects in high use area • >5 objects in low use area
INDICATORS: Factors Related to Human Disturbance of Fauna	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**
[13]**Feeding wildlife**	none	Either/Or • 1 person involved • 1 incidents during survey	Either/Or • 2-3 people involved • 2-3 incidents • during survey	Either/Or • 4-5 people and/or 2 groups (1-3 people) • 4-5 incidents	Either/Or • >5people and/or >2 groups • more than 5 incidents
[14]**Birds/animals scavenging**	none	• 1 bird or animal intermittent/nervous approach	• 1 or more birds or animals lingering near areas	• birds or animals approaching eating areas	• birds and animals resident in camp/picnic area approaching eating areas rummaging through rubbish

[15]**Disturbing wildlife** (e.g. throwing items, approaching)	none	Either/Or • 1 person involved • 1 incident during survey	Either/Or • 2-3 people involved • 2-3 incidents • during survey	Either/Or • 4-5 people and/or 2 groups (1-3 people) • 4-5 incidents	Either/Or • >5people and/or >2 groups • more than 5 incidents
[16]**Feral animals** (e.g. pigs, cats, cane toads presence/evidence)	none	Either/Or • 1-2 feral animals • 1 pile of scat • 1-2 diggings	Either/Or • 3-5 feral animals • 2-5 piles of scat • 3-5 diggings	Either/Or • 6-9 feral animals • 6-10 piles of scat • 6-10 diggings	Either/Or • 10 or more animals • >10 piles of scat • diggings around edge and within camp/picnic area
[17]**Domestic animals** (e.g. cats and dogs)	none	• 1 animal remains in vehicle	• 1 animal in area on leash	• 1 animal unsupervised / loose	• More than 1 animal loose
INDICATORS: Cumulative Impact (human, natural or management related)	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**
[18]**Hazardous plants** (e.g. stinging trees, calamus)	none	Either/Or • 1 clump calamus	Either/Or • 2 clumps calamus encroaching on cleared area	Either/Or • 3 clumps calamus encroaching on cleared area • 1 large patch on edge	Either/Or • 1-2 stinging trees • 3 clumps calamus encroaching on cleared area
[19]**Loose/slippery rocks/ algae on rocks**	non-slippery surface	• patches of loose stones but not slippery	• loose and slippery surface at entrance point	• very slippery at entrance points and on rocks in water body	• extremely slippery along bank and within water body
[20]**Potholes/bogs**	none	Either/Or • 1-2 small (5cm diameter) potholes at entrance point • <10% area potholes or bog	Either/Or • 3-6 small potholes at entrance point • 2 large (10 cm dia. 3-5 cm deep) • 2 large boggy areas • 10-20% area boggy	Either/Or • 7-10 small potholes at entrance point • 3 large potholes • 3 large boggy areas • 20-30% area boggy	Either/Or • 10 small potholes • > 3 large potholes • >30% area boggy
[21] **Bank Erosion**	none	Either/Or • Minimal erosion at access point • < 5% of bank eroded	Either/Or • 2-3 erosion points along bank at/near access point • 5-20% bank	Either/Or • Substantial erosion at main access point and several (>3) erosion points along bank • 30% bank	• Extensive erosion along bank and access point

[22]**Storm damage**	none	• twigs and leaves down	• small broken branches, scattered debris (twigs and leaves)	Either/Or • large broken branches • some infrastructure damage	Either/Or • fallen trees • major infrastructure damage
[23]**Road impact** (e.g. noise, dust)	none	• some muffled traffic noise	• noticeable dust and or traffic noise	• excessive dust and traffic noise	• excessive dust causing plant death and deafening traffic noise
INDICATORS: Vegetation	**1 Not Discernable**	**2 Minor Change**	**3 Moderate Change**	**4 High Change**	**5 Major/Severe Change**
[24]**Water weeds** (e.g. filamentous and blue-green algae)	none	• few isolated patches	• several patches moderate cover on edge and in shallows	• throughout water body	• foaming on surface • choking water body
[25]**Weeds on bank**	none	• >10% weeds	• 10-20% weeds	• 20-30% weeds	• >30% weeds
[26]**Midstorey and canopy patch death**	none	• 1-2 open patches	Either/Or • 3-5 open patches • 2 patches coalescing	Either/Or • 6-10 open patches • >2 patches coalescing	• > 10 patches, with several large patches
[27]**Exposed roots** that are not natural along edge of bank and entrance point to water body	0-1 trees	• 2-3 trees/100m bank	Either/Or • 4-6 trees/100m bank • at least 1 tree in high use area	Either/Or • 7-10 trees/100m bank • 2-5 trees in high use area	Either/Or • 10 trees/100m bank • > 5 trees in high use area

RESEARCHER MONITORING

This component consists of four parts. The first is to conduct a semi-intensive survey of the camp and picnic area (Table 14); the second to conduct semi-intensive surveys of the walking track (Table 15); the third to conduct belt transects (Table16) of the habitat bordering the camp and picnic area, and the fourth to conduct a transect parallel to a water feature (Table 17).

Both camp and picnic, and walking track surveys require measurements to be taken in the tread, buffer (edge of mown area or edge of track) and forest (control; ten metres into the forest). A single measurement of each variable is taken in each one square metre quadrant (Table 16), except for soil compaction and leaf litter depth where four measurements are taken per quadrat. The method of analysis and equipment for measuring each variable is reported in Volume 2 of this report.

Transect Adjacent to a Water Body

At waterholes a fixed transect fifty metres long by one metre wide needs to be scored at one-metre intervals for the presence or absence of weeds. Samples of weeds should be taken for identification and for the Queensland Herbarium. An attempt at identifying the source of the weed should be made, e.g. from upstream activity or visitor activity. It should also be noted if weeds are flowering or seeding.

Frequency of Monitoring

We recommend that semi-intensive monitoring be conducted every two years. More frequent semi-intensive monitoring will be required where negative trends are identified at the land manager level of monitoring that require objectives to be revised by management.

Table 14: Camp and Picnic Area Proforma for semi-intensive monitoring.

Location:		**Date:**
Time Start:	**Time Finish:**	**Total Time:**
Recorder:	**Person (s) taking measurements:**	
Sample Number:	☐ Campsite ☐ Picnic/Day Use Area	**Distance to water (m):**
Location of sample in campsite picnic area:		
Camp Fires permitted: ☐ YES ☐ NO	**Undesignated camp fires:** ☐ YES ☐ NO	

A. General Overview of Sampling Area

Approx. Area (length x width) (m):	**Barren ground:** A. ☐ None ☐ Clumped or ☐ Scattered Patches B. ☐ Around BBQ ☐ Around Picnic Table
Percentage of barren ground:	
Percentage of trees damaged:	**Type of tree damage:** ☐ Bark stripped ☐ Axe cuttings ☐ Branches broken ☐ Ring barking ☐ Other (explain):
Evidence of illegal camp fires: ☐ YES ☐ NO **If yes, number of illegal camp fires:**	
Number of social trails:	
Human waste (identify items): impact area periphery area control area	

B. Quadrat Sampling: At each campsite/picnic area, take three replicate quadrats of core, periphery and control. Take four measures in each quadrat for litter depth and soil compaction.

Variable	Core Impact site	Periphery	Control (ten metres from periphery)
Percentage of ground vegetation cover	1..... 2..... 3.....	1..... 2..... 3.....	1..... 2..... 3.....
Percentage of mineral soil exposure	1..... 2..... 3.....	1..... 2..... 3.....	1..... 2..... 3.....
Percentage of organic litter cover	1..... 2..... 3.....	1..... 2..... 3.....	1..... 2..... 3.....
Organic litter depth (mm)	1.....	1.....	1.....
	2.....	2.....	2.....
	3.....	3.....	3.....

Variable	Core Impact site	Periphery	Control (ten metres from periphery)
Height of tallest grass	1..... 2..... 3.....	1..... 2..... 3.....	1..... 2..... 3.....
Height of tallest broadleaf	1..... 2..... 3.....	1..... 2..... 3.....	1..... 2..... 3.....
Height of tallest woody	1..... 2..... 3.....	1..... 2..... 3.....	1..... 2..... 3.....
Number of seedlings (dicotyledons)	1..... 2..... 3.....	1..... 2..... 3.....	1..... 2..... 3.....
Weeds (present/absent)	1..... 2..... 3.....	1..... 2..... 3.....	1..... 2..... 3.....
Soil compaction kg/cm^3	1..... 2..... 3.....	1..... 2..... 3.....	1..... 2..... 3.....
Percentage of canopy cover	1..... 2..... 3.....	1..... 2..... 3.....	1..... 2..... 3.....
Human litter (present/absent)	1..... 2..... 3.....	1..... 2..... 3.....	1..... 2..... 3.....
Slope: level (2^o); gentle (2-5^o); moderate (6-18^o); steep (19-30^o); very steep (31-45^o); precipitous (45^o)	1..... 2..... 3.....	1..... 2..... 3.....	1..... 2..... 3.....

Table 15: Walking Track Proforma for semi-intensive monitoring

Site/Locality:			**Date:**	**Photo:**
Time Start:	**Time Finish:**		**Total Time:**	
Recorder:	**Photo:** ☐ NO ☐ YES, where:			
Track Manager:	**Track Name:**			
Altitude: Highest Point: Lowest Point:	**Track length:**	**Difficulty:** ☐ Easy ☐ Moderate ☐ Hard		
Distance between samples (track length/20):	**GPS:**			
Track theme:	☐ Rainforest walk ☐ Lookout	☐ Waterfall ☐ Cultural	☐ Swimming hole	
Track surface:	☐ Dirt ☐ Concrete	☐ Gravel ☐ Boardwalk	☐ Bitumen	
(Combination – give percentage of each type):				
Track construction:	☐ Steps	☐ Handrails	☐ Seats	☐ Shelters
Track classification:	☐ Pathway	☐ Rough track	☐ Graded track	☐ Trail route
Signage:	☐ Track name ☐ Regulatory ☐ Trail markers	☐ Pictograms ☐ Warning ☐ Informative/educational	☐ Self registration ☐ Directional	
Vegetation:	☐ Rainforest ☐ Open wood land	☐ Wet sclerophyll ☐ Mangrove	☐ Dry sclerophyll ☐ Mixed	
Vegetation (dominant species):				
Feral animals: ☐ Present ☐ Evidence **Comment:**				

Table 16: Measurements to be made within one-square-metre quadrats on (a) tread zone, (b) buffer zone and (c) control zone.

(a) Tread Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
% Mineral soil exposure																				
% Litter cover																				
% Root exposure																				
% Rock																				
% Fungi																				
% Woody debris																				
Soil erosion -scale																				
% Soil erosion																				
% Soil compaction																				
% Litter cover -depth																				
% Canopy cover																				
Ease of walking - loose stones																				
Ease of walking-vines																				
Seedling density																				
Safety/slope																				
Height grass																				
Height broad leaf																				
Height woody seedlings																				
Human Litter																				
Weeds (+/-)																				
Dieback (+/-)																				
Comments (e.g. depth and extent of erosion)																				

(b) Buffer Zone Sections	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Track widening																				
Ground vegetation cover <1m overhanging vegetation																				
% Mineral soil exposure																				
% Ground vegetation cover																				
% Litter cover																				
% Root exposure																				
% Rock																				
% Fungi																				
% Woody debris																				
Soil erosion -scale																				
% Soil erosion																				
% Soil compaction																				
Litter cover -depth																				
% Canopy cover																				
Seedling density																				
Epiphytes/lianas																				
Slope																				
Height grass																				
Height broad leaf																				
Height woody seedlings																				
Human Litter																				
Weeds (+/-)																				
Dieback (+/-)																				

Comments

(c) Control Sections	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
%Ground vegetation cover <1m overhanging vegetation																				
% Mineral soil exposure																				
% Ground veg.cover																				
% Litter cover																				
% Root exposure																				
% Rock																				
% Fungi																				
% Woody debris																				
Soil erosion -scale																				
% Soil erosion																				
Soil compaction																				
Litter cover -depth																				
% Canopy cover																				
% Canopy cover																				
Seedling density																				
epiphytes/lianas																				
Slope																				
Height grass																				
Height broad leaf																				
Height woody seedlings																				
Human Litter																				
Weeds (+/-)																				
Dieback (+/-)																				

Comments

Table 17: Proforma for semi-rapid assessment of the status of vegetation and human litter at camp and picnic area using belt transect.

SITE:
RECORDER:
DATE: **TIME START:** **TIME FINISH:** **TOTAL TIME:**

Transect length: Fifteen metres (in 0.5 metres lengths) with human litter sampled to twenty metres. **SCORE:** 0=Absent; 1=Present

Rule: Start at edge of mowing or clearing; belt width ten centimetres either side except for human litter one metre either side (N.B. Note type of human litter).

	Vegetation		Understorey Vegetation Type						Erosion				Human		Height	
	Native	Exotic	Grass	Broad Leaf	Woody	Tree (>2m)	Vines	Ferns	Leaf litter	Bare soil	Root Exposure	Rock	Human litter	Trampling	tallest grass	tallest broad leaf
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																
16																
17																
18																
19																
20																
21																
22																
23																
24																
25																

	Vegetation		Understorey Vegetation Type						Erosion				Human		Height	
	Native	Exotic	Grass	Broad Leaf	Woody	Tree (>2m)	Vines	Ferns	Leaf litter	Bare soil	Root Exposure	Rock	Human litter	Trampling	tallest grass	tallest broad leaf
26																
27																
28																
29																
30																
31																
32																
33																
34																
35																
36																
37																
38																
39																
40																
41																
42																
43																
44																
45																
46																
47																
48																
49																
50																
Freq																

REFERENCES

ACTFR Report No. 16/96. (No date). *Ecotourism, Water Quality and Wet Tropics Streams*. Australian Centre for Tropical Freshwater Research, James Cook University, Townsville.

Alexandra, J., Higgins, J. and White, T. (1998). *Environmental Indicators for National State of the Environment Reporting: Community and Local Uses. Australia State of the Environment (Environmental Indicator Reports)*. Department of the Environment and Heritage, Canberra.

Australia and New Zealand Environment and Conservation Council (ANZECC) (2001). *Best Practice in Cultural Heritage Management*. ANZECC Working Group on National Parks and Protected Areas Management: Benchmarking and Best Practice Program. Department of the Environment and Heritage, Canberra.

Australia and New Zealand Environment and Conservation Council (ANZECC) (2000). *Core Environmental Indicators for Reporting on the State of the Environment.* Department of the Environment and Heritage, Canberra.

BBC Consulting Planners and Environmental Affairs Pty Ltd (BBC and EAP) (1994). *Social Impact Assessment: Commonwealth Environmental Impact Assessment Review.* Consultant's report prepared for Assessment and Coordination Section, Environment Assessment Branch, Commonwealth Environment Protection Agency, Canberra.

Becker, E. and Jahn, T. (1999). (*Eds*) *Sustainability and the Social Sciences*. Zed Books, London.

Bell, S. and Morse, S. (1999). *Sustainability Indicators: Measuring the Immeasurable*. Earthscan, London.

Bentrupperbäumer, J. M. and Reser, J. P. (2002a). *Measuring and Monitoring Impacts of Visitation and Use in the Wet Tropics World Heritage Area: A Site-Based Bioregional Perspective*. Rainforest CRC, Cairns.

Bentrupperbäumer, J. M. and Reser, J. P. (2002b). *The Role of the Wet Tropics in the Life of the Community: A Wet Tropics World Heritage Area Community Survey 2001/2002*. Rainforest CRC, Cairns.

Bentrupperbäumer, J. M. and Reser, J. P. (2000). *Impacts of Visitation and Use: Psychosocial and Biophysical Windows on Visitation and Use in the Wet Tropics World Heritage Area.* Rainforest CRC, Cairns.

Bentrupperbäumer, J. M., Reser, J. P and Turton, S. (1998). *Impacts of Visitation and Use on the Wet Tropics World Heritage Area: Psychosocial and Biophysical Impacts of Visitation and Use*. Report to the Wet Tropics Management Authority.

Bright, A. D., Cordell, H. K., Hoover, A. P. and Tarrant, M. A. (1999). *Guidelines for Conducting Social Assessments within a Human Dimensions Framework*. Report to Ecosystem Management Coordination Staff, USDA Forest Service, Washington, D.C.

Cole, D. (1978). Estimating the Susceptibility of Wildland Vegetation to Trailside Alteration. *Journal of Applied Ecology* **15:** 281-286.

Cole, D. (1982). *Wilderness Campsite Impacts: Effect of Amount of Use*. USDA Forest Service, Intermountain Forest and Range Experiment Station, Research Paper INT-284, Utah.

Cordell, H. K. and Bergstrom, G. (1999). *Integrating Social Sciences with Ecosystem Management*. Sagamore Publishing, Champaign, Illinois.

Craik, K. H. and Feimer, N. R. (1987). Environmental Assessment. *In* D. Stokols and I. Altman (*Eds*) *Handbook of Environmental Psychology*. Vol 2 (pp891-918). Wiley, New York.

Craik, K. H. and Zube, E. H. (1975). *Issues in Perceived Environmental Quality Research*. Amherst. University of Massachusetts.

Driml, S. (1997). *Towards Sustainable Tourism in the Wet Tropics World Heritage Area*. Report to the Wet Tropics Management Authority, Cairns.

Eckersley, R. (1998). (*Ed*) *Measuring Progress: Is Life Getting Any Better*? CSIRO Publishing, Collinwood.

Gifford, R. (1997). *Environmental Psychology: Principles and Practice*. Second Edition. Allyn and Bacon, Boston.

Gobster, P. H. (1999). An Ecological Aesthetic for Forest Landscape Management. *Landscape Journal* **18:** 54-64.

Graef, A. R., Kuss, F. R. and Vaske, J. J. (1990*). Visitor Impact Management: The Planning Framework.* National Parks and Conservation Association, Washington D.C.

Hall, C. M. and McArthur, S. (1996). *Heritage Management in Australia and New Zealand: The Human Dimension.* Second Edition. Oxford University Press, Oxford.

Hamblin, A. (1997). *Proposed Indicators of Land Resources for National State of the Environment Reporting*. Environment Australia, Canberra.

Hammitt, W. and Cole, D. (1998). *Wildland Recreation. Ecology and Management*. Second Edition. John Wiley and Sons, New York.

Hartig, T. (1993). Nature Experience in Transactional Perspective. *Landscape and Urban Planning* **25:** 17-36.

Hockings, M. (2000). *Evaluating Effectiveness: A Framework for Assessing the Management of Protected Areas*. IUCN, Gand, Switzerland.

Horneman, L. (1999). The Development of a Standardised Methodology for Improving the Management of Visitors to Natural Areas. SPIRT Development Grant and Project Summary.

Horneman, L. N., Beeton, R. J. S., and Hocking, M. (2002). *Monitoring Visitors to Natural Areas: A Manual with Standard Methodological Guidelines*. A Manual prepared for the Queensland Parks and Wildlife Service, New South Wales National Parks and Wildlife Service and Sport and Recreation Queensland. The University of Queensland, Gatton.

Jusoff, K. (1989). Physical Soil-properties Associated with Recreational Use of a Forested Reserve Area in Malaysia. *Environmental Conservation* **16(4):** 339-342.

Kuss, F. and Graefe, A. (1985). Effects of Recreational Trampling on Natural Area Vegetation. *Journal of Leisure Research* **17(3):** 165-183.

Manning, R. E. (1999). *Studies in Outdoor Recreation: Search and Research for Satisfaction*. Second Edition. Oregon State University Press, Corvallis.

Margoluis, R. and Salafsky, N. (1998) *Measures of Success: Designing, Managing and Monitoring Conservation and Development Projects*. Island Press, Washington D.C.

McDonald, G. and Lane, M. (2000) *Securing the Wet Tropics?* The Federation Press, Annandale NSW.

Moscardo, G. and Ormsby J. (2000) A Social Indicators Monitoring System for Tourist and Recreational Use of the Great Barrier Reef. Report prepared for the Great Barrier Reef Marine Park Authority, Townsville.

Newton, P. W. (1998) Environmental Indicators for Human Settlements. *In* R Eckersley (*Ed*) *Measuring Progress: Is Life Getting Better?* (pp 319-327). CSIRO Publishing, Collingwood VIC.

Ormsby, J., Moscardo, G., Pearce, P. and Foxlee, J. (2000) *A review of research into tourist and recreational uses of protected natural areas.* Report prepared for the GBRMPA. Townsville. James Cook University, Tourism Program, School of Business.

Pearce, P. (1988) *The Ulysses Factor: Evaluating Visitors in Tourist Environments*. Springer Verlag, New York.

Pearce, P. L. and Moscardo, G. (1997) Tourism Community Analysis. Paper presented to the International Academy for the Study of Tourism Conference. Malacca, Malaysia. 21-25 June.

Pearce, P. L., Moscardo, G. M. and Ross, G. F. (1996) *Tourism Community Relationships*. Elsevier, Oxford.

Queensland Department of the Environment (1998) *Gold Coast Hinterland Landscape Strategy Plan*. Vols 1-3. Department of the Environment, Queensland.

Sheppard, S. R. J. and Harshaw, H. W. (2001) (*Eds*) *Forests and Landscapes: Linking Ecology, Sustainability and Aesthetics*. CABI Publishing, New York.

Taylor, C. N., Bryan, C. H. and Goodrich, C. G. (1995) *Social Assessment: Theory, Process and Techniques*. Second Edition. Taylor Baines and Associates, Christchurch.

Sun, D. and Liddle, M. (1991). Field Occurrence, Recovery and Simulated Trampling Resistance and Recovery of Two Grasses. *Biological Conservation*. **57:** 187-203.

Sun, D. and Liddle, M. (1993). A Survey of Trampling Effects on Vegetation and Soil in Eight Tropical and Subtropical Sites. *Environmental Management*. **17(4):** 497-510.

Talbot, L., Turton, S. and Graham, A. (2002).*Trampling Resistance of Tropical Rainforest Soils and Vegetation in the Wet Tropics of Northeast Australia*. In press.

Thomas, I. (1998) *Environmental Impact Assessment in Australia: Theory and Practice*. Second Edition. The Federation Press, Annandale NSW.

Turton, S., Kluck, T. and Day, T. (2000) Ecological Impacts of Visitors at Day-use and Camping areas. *In* Bentrupperbäumer, J. and Reser, J. *Impacts of Visitation and Use: Psychosocial and Biophysical Windows on Visitation and Use in the Wet Tropics World Heritage Area. Final Report Stage 2.* Rainforest CRC, Cairns.

United Nations (2001) *Indicators of Sustainable Development: Guidelines and Methodologies*. United Nations, New York. http://www.un.org/esa/sustdev/isd.htm

United Nations (1996) *Indicators of Sustainable Development: Framework and Methodologies*. United Nations, New York.

Vanclay, F. (2002) Conceptualising Social Impacts. *Environmental Impact Assessment Review* **22:** 183-211.

Vanclay, F. and Bronstein, D. A. (1996) (*Eds*) *Environmental and Social Impact Assessment*. John Wiley, New York.

Wallin, T. and Harden, C. (1996) Estimating Trail-related Soil Erosion in the Humid Tropics: Jatun Sacha, Ecuador and La Selva, Costa Rico. *Ambio* **25(8):** 517-522.

Wet Tropics Management Authority (2000) *Wet Tropics Nature Based Tourism Strategy*. Wet Tropics Management Authority, Cairns.

Wet Tropics Management Authority (2001) *Wet Tropics Walking Strategy.* Wet Tropics Management Authority, Cairns.

Worboys, G., Lockwood, M. and DeLacy, T. (2001) *Protected Area Management: Principles and Practice*. Oxford University Press, Melbourne.

World Heritage Unit, Environment Australia (WHU) (1998) *Monitoring the Conservation of Australia's World Heritage Areas*. Section 4. Draft Guidelines for Monitoring the Conservation of Australia's World Heritage Areas. Environment Australia, Canberra.

APPENDIX – EXPLANATIONS AND DEFINITIONS

Explanations and definitions of terms:

1. indicators
2. visitor management
3. carrying capacity (CC)
4. visitor impact management model (VIMM)
5. visitor experience and resource protection model (VERP)
6. visitor activity management program (VAMP)
7. limits of acceptable change (LAC)
8. tourism optimisation management model (TOMM)
9. social indicators

---

1. Indicators should:

a) be capable of identifying changes in environmental conditions (quantity and quality) and the cause (agents) of these changes;
b) be understandable to the general public and decision makers as well as scientists;
c) be limited in number if they are to be useful for decision makers;
d) be scientifically defensible;
e) be sensitive to change in space and time;
f) be based on relative ease of data collection, and where possible and appropriate, be based on existing data collection, storage, retrieval and interpretation programmes; and
g) provide early warning of adverse environmental effects.

"Above all, indicators need to be useful tools; the reason for their existence is that they aid understanding, and help managers to avoid risks … with more complete knowledge of likely outcomes." (Manning 1992, p5)

2. Visitor Management

"the management of visitors in a manner that maximises the quality of the visitor experience while assisting the achievement of the area's overall management objectives" (Hall and McArthur 1996).

3. Carrying Capacity

Widely used model in visitor management (Glasson *et al.* 1995 in McArthur 2000). Basis is to compare the amount of visitor activity (number of visitors) with the scale of the impacts generated by the tourism (Hall 1995 in McArthur 2000). Problem is each impact (e.g. economic, social, psychological, biophysical, cultural, ecological) has a different carrying capacity equation which is not integrated, making the decision to use these difficult for management (McArthur 2000). Extensive research into environmental and social impacts has failed to establish links between different levels of use and their impacts (refs. In McArthur 2000). Model is considered too simplistic to be useful (McArthur 2000). *"Most visitor managers have shifted their focus from a relationship between levels of use and impact (CC model) to identifying desirable conditions for visitor activity to occur in the first*

place … they monitor the experience of the visitor and the state of the forest." (McArthur 2000).

4. Visitor Impact Management Model (VIMM)

Depends on identifying the cause of visitor impact and generating strategies to deal with it. It has a relatively conservative focus on minimising impacts. It addresses the state of the environment and, to some extent, the quality of the visitor (McArthur 2000).

5. Visitor Experience and Resource Protection Model (VERP)

This model was established to determine the most appropriate visitor experiences based on *values* and *significance*, then determine specific conditions for the forest environment to maintained too (Falvey 1996 in McArthur 2000). The VERP is added to the VIMM model by applying the designated experiences and forest conditions to a zoning system, then applying a monitoring system to check both are in order. Once completed the VERP is linked to its region's management plan, which is approved by an act of government and thus becomes a legal document' providing consistency and legislative strength (McArthur 2000).

6. Visitor Activity Management Program (VAMP)

This model is a planning system that integrates visitor needs with resources to produce specific visitor opportunities. Shades of ROS.

7. Limits of Acceptable Change (LAC)

This model goes beyond VIMMs by generating opportunity classes or zones to describe management approaches to the forest environment, then varying each class to maximize the conservation of the resource and quality of the visitor experience. The LAC model establishes how much change is acceptable, then manages visitors and forest to keep conditions under these limits (Clarke and Stankey 1979; Stankey and McCool 1984; McCool and Stankey 1992). Specifically LAC determines what conditions are most desirable, then monitors the actual situation to determine whether the conditions are within acceptable standards. It is strongly focused on decision making. This model was designed to serve a single natural area management organisation within one land tenure.

8. Tourism Optimisation Management Model (TOMM)

This is a broader version of LAC that is designed to:

- monitor and quantify the key economic, marketing, environmental, socio-cultural and experiential benefits and impacts of tourism activity; and
- assist in the assessment of emerging issues and alternative future management options for the sustainable development and management of tourism activity (Manidis Roberts 1996 in McArthur 2000).

This model has more emphasis on contextual analysis and monitoring program than LAC (McArthur 2000). This model was designed to serve a multitude of stakeholders with a multitude of interests, and can operate at the regional level over a multitude of public and private land tenures.

9. Social Indicators

“can be monitored over time … can be aggregated to the level of relevant social unit …The set of indicators should be ‘limited’ so that a substantial portion of the most salient or critical aspects of society is included. They should be ‘coherent’ in that it would be helpful to our understanding if they hung together in some form that would eventually lead to a model or theory about how society operates.” (Andrew and Withey 1976).