

ERCB/AGS Roles and Responsibilities Manual for the Turtle Mountain Monitoring Project, Alberta

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F. Moreno and C.R. Froese

Energy Resources Conservation Board
Alberta Geological Survey

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Energy Resources Conservation Board
Alberta Geological Survey
4th Floor, Twin Atria Building
4999 – 98th Avenue
Edmonton, Alberta
T6B 2X3
Canada
Tel: 780.422.3767
Fax: 780.422.1918
E-mail: AGS-Info@ercb.ca
Website: www.ags.gov.ab.ca

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Abstract

The Turtle Mountain Monitoring System (TMMS) is a near-real-time monitoring system that provides data from a network of more than 80 geotechnical sensors on the South Peak of Turtle Mountain (site of the 1903 Frank Slide) in the Crowsnest Pass. As of April 1, 2005, the Alberta Energy and Utilities Board (now the Energy Resources Conservation Board (ERCB)), through Alberta Geological Survey (AGS), took ownership of this system and responsibility for the long-term monitoring, interpretation of data and notification of the Alberta Emergency Management Agency (AEMA) should significant movements occur. A separate document prepared by AEMA outlines the action plans for the stakeholders and first responders in the Crowsnest Pass, whereas this document outlines the specific roles and responsibilities of ERCB staff during normal operation of the system and during an emergency.

1 Introduction

On April 29, 1903, 30 million m³ of rock failed catastrophically and buried a portion of the Town of Frank, killing more than 70 people. Subsequent studies revealed that another portion of the mountain, referred to as South Peak, has similar geological conditions and is surrounded by a series of deep fissures. It is almost certain that South Peak will fail, and it is estimated that it could bring down a rock avalanche with a volume of approximately 5 million m³ (Moreno and Froese, 2008). Such a slide is projected to cover Highway 3, the Canadian Pacific Railway (CPR) mainline, acreage residential development, commercial properties, and a sports and recreation complex that is currently under construction (BGC Engineering, 2000; Hungr Geotechnical Research, 2007).

To provide early warning for such an event, the Government of Alberta (GOA) funded a \$1.1 million monitoring project to install a near-real-time warning system at South Peak. This system consists of more than 80 sensors connected to data loggers and radios that can collect and transmit data at preprogrammed intervals. These data can be viewed via the Internet and fed into a system that sends out warnings based on exceedance of predetermined thresholds for each sensor, as defined by Alberta Geological Survey (AGS). A more detailed description of the threshold-determination rationale is provided by Froese et al. (2005).

Based on a review of the sensor configurations and thresholds, a system of four alert levels (green, yellow, orange and red) was developed by AMEC (Froese et al., 2005). This has been incorporated into Alberta Emergency Management Agency's (AEMA) Emergency Response Protocol (ERP) for Turtle Mountain (Alberta Emergency Management Agency, 2008). Tables 1–3 provide an overview of the alert levels and corresponding responses that have been incorporated into the ERP.

All internal ERCB roles and responsibilities pertaining to the Turtle Mountain Monitoring System (TMMS) will also be referenced to the same four-stage alert system to maintain consistency for all parties involved.

2 General Responsibilities

Energy Resources Conservation Board/Alberta Geological Survey is responsible for determining the appropriate alert level for a potential or actual emergency at Turtle Mountain and for providing technical expertise to AEMA during an event. These ERCB/AGS roles will ensure that the main objectives of the AEMA Emergency Response Protocol (ERP; Alberta Emergency Management Agency 2008) are fulfilled. The ERCB/AGS Turtle Mountain (TM) Team is responsible for timely and efficient information review and delivery, both internally to ERCB and externally to AEMA. The team consists of the TM Leader, TM Staff, AGS Management Representative and Emergency Response Group, as well as the ERCB Information Technology (IT) Network Group and the Solicitor General (SOLGEN) Communication Centre. Not all positions would necessarily be activated during a particular alert level.

This document establishes the chain of command, identifying key individuals at ERCB who will fill each position and clearly defining their roles and responsibilities so they can effectively manage any alert situation. A hierarchy is also defined for reporting rock-displacement alerts and other critical information to appropriate individuals at each stage of the response. Development of this communication structure was based on the recommendations in the training material produced by United States Environmental Protection Agency (2003). It should be noted that the number of people notified will increase as the level of alert rises and decrease as it moves toward its conclusion (e.g., all communications and notifications are internal during alert level green). To avoid false alarms, any call for a modification of the alert level must be evaluated in the context of typical seasonal fluctuations in displacement and experience gained over time in interpreting those fluctuations. This plan is designed to consider a careful evaluation of a displacement alarm and to have the appropriate response based on that evaluation.

Table 1. Expected response during alert level green, Turtle Mountain.


Alert Level	Activity Level	Instrumentation Behaviour	Response
Green – No Immediate Risk 	Background noise or seasonal fluctuations	No change in monitoring data from background levels; no concern	ERCB/AGS: Normal operations plus information calls to GOA and local authorities as appropriate
	Ongoing trends independent of seasonal effects	No significant or unusual change noted in data trends; no immediate concern	ERCB/AGS: Continue monitoring
	Alarm triggers on one sensor	Change noted in data; no immediate cause for concern	ERCB/AGS: Continue monitoring and field check instrument as appropriate Further evaluate as to whether a Yellow level is appropriate

Table 2. Expected response during alert levels yellow and orange, Turtle Mountain.



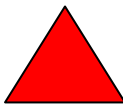
Alert Level	Activity Level	Instrumentation Behaviour	Response
Yellow – Watch 	Multiple sensors detect movements that are nonseasonal but only slightly above threshold levels	Some increased rock mass movement; some potential concern	ERCB/AGS: Increase frequency of data review and/or data acquisition Heads-up notification to AEMA Reset sensor threshold levels and communicate to all team members AEMA: Inform Municipality of Crowsnest Pass (MCNP) Director of Disaster Services and AEMA District Manager
Orange – Warning 	Multiple sensors exhibit acceleration of data trends significantly exceeding threshold values (nonseasonal)	Accelerating movements across a significant area; elevated concern Some instrumentation may go out of range and/or communication may be lost	ERCB/AGS Response: Increase frequency of data review, visit site to check conditions, communicate findings to key decision-makers, and recommend voluntary evacuation Reset sensor threshold levels and communicate to all team members; continue to inform AEMA and internal and external staff experts; begin visual checks on mountain Subject matter expert (SME) prepared to move to MCNP AEMA Response: Inform MCNP Director of Disaster Services and AEMA District Manager MCNP: Activate Emergency Operations Centre (EOC); issue voluntary evacuation advisory/ evacuation warning

Table 3. Expected response during alert level red, Turtle Mountain.

Alert Level	Activity Level	Instrumentation Behaviour	Response
Red – Event in Progress 	High or catastrophic acceleration on several sensors; initiation of full-scale rock-mass movement	Major acceleration of movements, and visual observations of movements across a broad area; monitoring instrumentation may be destroyed and/or communication lost	ERCB/AGS: Continue to evaluate instrumentation readings and site conditions Trigger Emergency Response Plan, including evacuations and mobilization of emergency services Reset sensor threshold levels and communicate to all team members Visual checks of mountain AEMA: Activate Emergency System Notification MCNP: Fully activate EOC, evacuation and Emergency Public Warning System Alberta Transportation/RCMP/CPR: Close Highway 3 and railway

The primary Emergency Operations Centre (EOC) during orange and red alerts will be provided by the Municipality of Crowsnest Pass (MCNP). This site will be determined at the time. The EOC must have sufficient communication equipment (telephones, computers, two-way radios, etc.), copies of geotechnical reports, white boards, and tables and chairs to meet the needs of those individuals assigned to the location. High-speed internet access must also be available. This service is critical to the warning system, as it allows AGS access to geotechnical data from the mountain for interpretation. An alternate EOC will be set up at the Crowsnest Pass Provincial Building, 12501 20th Avenue, Blairmore (Figure 1), should Internet connectivity at the primary EOC be lost.

2.1 ERCB/AGS Turtle Mountain Leader

The ERCB/AGS Turtle Mountain (TM) Leader is accountable for the Turtle Mountain Monitoring System (TMMS) Team and its mandate by

- ensuring the ERCB/AGS TM Team fulfills its delegated response and tasks (including procedures for data review and reporting);
- presenting a periodic assessment to the AEMA Duty Officer (by phone; Table 4) of continuing risks, and any changes of alert level;
- briefing AGS Management Representative and Emergency Response Group (ERG; by phone) when the alert level is changed;
- implementing the response actions according to the alert level;
- determining what resources are required to adequately deal with the alert level;
- communicating effectively with all participants involved in the emergency, including those outside of the ERCB command structure;
- acting as an interagency liaison to ensure a cohesive and co-ordinated response;

- providing accurate information at the appropriate time to the emergency response agencies or individuals responsible for receiving and managing information on-site before, during and after a rock-slope failure at Turtle Mountain;
- establishing and maintaining policies and procedures for regular data review, reporting and actions;
- ensuring proper allocation of personnel to address issues with the monitoring system; and
- ensuring the TM Team meets its roles and responsibilities.

2.2 Turtle Mountain Staff

The TM Staff reports to the ERCB/AGS TM Leader and are responsible for

- conducting system diagnostic checks, appropriate to the alert level, to confirm instrument functionality, power supply, radio links and hardware functionality;
- scheduling maintenance and repair, as required, of equipment supported by ERCB/AGS TM Staff (per Table 5) and/or notifying the ERCB IT Network Group of any functionality problems found in the software and network equipment supported by that group (Table 6);
- notifying the ERCB IT Network Group of any updates or upgrades made to hardware and/or software supported by the ERCB/AGS TM Team (per Table 5);
- identifying and maintaining a set of spare parts for the most critical components of the instrumentation system;



Figure 1. Location of alternate Emergency Operations Centre (EOC) at the Crownsnest Pass Provincial Building in Blairmore. Image from Google Earth™ mapping service.

Table 4. Emergency contact numbers list. Numbers omitted intentionally.

Team/Group	Name	Phone		
		Work	Cell	Home
ERCB/AGS TM Leader	XXX	XXX	XXX	XXX
TM Staff	XXX	XXX	XXX	XXX
AGS Management Representative	XXX	XXX	XXX	XXX
Emergency Response Group (ERG)	XXX	XXX	XXX	XXX
SOLGEN Communication Centre	XXX	XXX	XXX	XXX
ERCB IT Network Group	XXX	XXX	XXX	XXX
ERCB IT Network Management representative	XXX	XXX	XXX	XXX
Blairmore Provincial Building representative	XXX	XXX	XXX	XXX
Frank Slide Interpretive Centre (FSIC) representative	XXX	XXX	XXX	XXX
AEMA Duty Manager	XXX	XXX	XXX	XXX
ATCO Pipelines	XXX	XXX	XXX	XXX
Devon Energy Corporation	XXX	XXX	XXX	XXX
TransCanada Pipelines Limited	XXX	XXX	XXX	XXX

- being available to receive e-mail (a trigger from a single sensor) or voice call (triggers from multiple sensors) from the system and prepared to
 - a) conduct timely review of data and report and evaluate whether an increase (or decrease) in alert level is required; follow the procedure shown in Figure 2; if alert level increases or decreases, notify the ERCB/AGS TM Leader and IT Network representative;
 - b) take the lead role in the absence of the ERCB/AGS TM Leader and act as the main liaison between the external emergency response agencies and ERCB; changes in alert level must be reported to
 - i) AEMA Duty Officer (by phone),
 - ii) AGS Management Representative (by phone), and
 - iii) ERG Representative (by phone);
- undertaking system upgrades (only during alert level green) and repairs, as necessary, to maintain a reliable monitoring system;
- resetting sensor-threshold trigger levels after a change in alert level and communicating to all team members; and
- notifying the IT Network Group of
 - a) any escalation or decrease of alert level,
 - b) any reclassification of elements identified as being of primary, secondary and tertiary importance in the Service Level Agreement (Section 8), as emergency event progresses.

Table 5. Software and network equipment supported by ERCB/AGS TM Staff.

Blairmore Provincial Building								
Quantity	Vender	Part Number	Description	Location	AGS	IBM	Metafore	IT Support
1	Campbell	L14201	Antenna	roof	A/R			
1	Campbell	L14462	Antenna(surge protector)	roof	A/R			
1	Campbell	RF400	Radio	2nd floor	A/R			
1	Campbell	L15966	Radio (DC unit)	telecom room	A/R			
1	Campbell	NL100	Network interface	telecom room	A/R			
1	Campbell	L13947	Network interface (DC unit)	telecom room	A/R			
1	MTI	MT485028/N	Antenna	roof	A/R			
3'	YDI		Antenna (cable)	roof	A/R			
1	Smartbridges	AirHaul Nexus	Radio	roof	A/R			
1	Smartbridges		Radio (power injector)	telecom room	A/R			
1	Smartbridges		Antenna	roof	A/R			
1	Smartbridges	AirHaul Nexus	Radio	roof	A/R			
1			Coupler	2nd floor	A/R			
1	Smartbridges		Radio (power injector)	telecom room	A/R			
1	Smartbridges		Radio (DC unit)	telecom room	A/R			
Frank Slide Interpretive Centre (FSIC)								
Quantity	Vender	Part Number	Description	Location	AGS	IBM	Metafore	IT Support
1	MTI	MT485028/N	Antenna	roof	A/R			
1		LMR600	Antenna (cable)	roof	A/R			
1	Smartbridges	SB3010	Radio	roof	A/R			
1	Smartbridges		Radio (power injector)	attic	A/R			
1	Hyperlink Tecl	HG2416P	Antenna	roof	A/R			
1		LMR400	Antenna (cable)	roof	A/R			
1	Smartbridges	SB2510	Radio	attic	A/R			
1	Smartbridges		Radio (power injector)	attic	A/R			
1	Hyperlink Tecl	HG2416P	Antenna	roof	A/R			
1		LMR400	Antenna (cable)	roof	A/R			
1	Engenius	NL2510	Radio	attic	A/R			
1	Electro-comm	DA 58-29 PAC	Antenna	roof	A/R			
1		LMR400	Antenna (cable)	roof	A/R			
1	Smartbridges	SB3010	Radio	attic	A/R			
1	Smartbridges		Radio (power injector)	attic	A/R			
1	MTI	MT485028/N	Antenna	roof	A/R			
1		LMR600	Antenna (cable)	roof	A/R			
1	Smartbridges	SB3010	Radio	attic	A/R			
1	Smartbridges		Radio (power injector)	attic	A/R			
Pump house								
Quantity	Vender	Part Number	Description	Location	AGS	IBM	Metafore	IT Support
1	MTI wireless e	MT485028/N	antenna	roof	A/R			
1	Air Haul Nexu:	Smartbridges SB3010	radio	roof	A/R			
1			Radio (power injector)	inside	A/R			
1			Radio (power supply)	inside	A/R			
1	Novatel		GPS antenna	roof	A/R			
1	Novatel	SmartStar	GPS receiver	inside	A/R			
1		Lantronix	GPS (serial to ethernet)	inside	A/R			
1			GPS (power supply)	inside	A/R			
1	Mobotix	M22M	web camera	roof	A/R			
1	Mobotix	OPT14-L65	web camera (lens)	roof	A/R			
1			web camera (power supply)	inside	A/R			
1	Hawking		web camera	roof	A/R			
1	Hawking		web camera (lens)	roof	A/R			
1			web camera (power supply)	inside	A/R			
1			web camera (enclosure heater power	inside	A/R			
Software	Description	AGS	IBM	Metafore	IT Support			
PHP	Scripting language used 4dynamic web pages	A/R			I/C			
Apache	Apache provides web services	A/R			I/C			
ActivePerl	distribution of the Perl language	A/R			I/C			
Turtle Daemons	collects data acquisition systems at TM	A/R			I/C			
Campbell Scientific LoggerNet	Loggernet 4 Campbell Scientific brand of data loggers	A/R			I/C			
MS .Net Framework 2.0	.NET framework is required by TMClient	A/R			I/C			
java Development Kit (JDK)	runtime environment for Java application & the Java compiler	A/R			I/C			
Marshall	accepts seismic data from seismic data digitizers	A/R			I/C			
AutoTAR	AutoTar analyses data from the seismic digitizers	A/R			I/C			
Vlinx Ethernet Serial Server	connects the weather station to the computer over Ethernet.	A/R			I/C			
One Wire Weather station software	OWW reads data from the weather station at the FSIC	A/R			I/C			
Kiwi System Log Daemon	accepts log data	A/R			I/C			
UDPDL	Updates firmware 4 Gennix seismic digitizers	A/R			I/C			
FireDaemon	makes programs look like A services	A/R			I/C			
AirPoint Pro	used to configure Smartbriges	A/R			I/C			
ConText	Text editor program like notepad	A/R			I/C			
WinSCP	to transfer encrypted files without a VPN	A/R			I/C			

Legend: A=Accountable, R=Responsible, I=Informed, C=Consulted

Table 6. List of supported software and network equipment by ERCB IT Network Group.

Blairmore Provincial Building

Quantity	Vender	Part Number	Description	Location	AGS	IBM	Metafore	IT Support
1	Checkpoint	safe@office 500	Router	telecom room	I/C	IBM		A/R
1	Shaw Cable		Internet (modem)	telecom room	I/C			A/R
1	Shaw Cable		Internet (subscription)	telecom room	I/C			A/R
1	NCIX	CPS 1000 AVR	Battery back-up (UPS)	telecom room	I/C			A/R

Frank Slide Interpretive Centre (FSIC)

Quantity	Vender	Part Number	Description	Location	AGS	IBM	Metafore	IT Support
1	D-Link	8-port	HUB	attic	I/C	IBM		A/R
1	D-Link	8-port	HUB	electrical room	I/C	IBM		A/R
1	HP Server	Xeon 3.4 Ghz 2GB Ram	Data analysis, Marshall, Snapping, Da	electrical room	I/C		Metafore	A/R
1	HP Server	Monitor		electrical room	I/C			A/R
1	HP Server	Network Card		electrical room	I/C		Metafore	A/R
1	HP Server	UPS		electrical room	I/C			A/R
1	Hawking	4-port	HUB	attic	I/C	IBM		A/R

Pump house

Quantity	Vender	Part Number	Description	Location	AGS	IBM	Metafore	IT Support
1	Netgear	FS116NA	Ethernet switch	inside	I/C			A/R
1			Ethernet switch (power supply)	inside	I/C			A/R
1	Belkin	F6H375-USB	UPS	inside	I/C			A/R

Software	Description	AGS	IBM	Metafore	IT Support
Windows 2003		I/C			A/R
Arcserve Agent		I/C			A/R
SQL		I/C			A/R

Legend: A=Accountable, R=Responsible, I=Informed, C=Consulted

2.3 AGS Management

Alberta Geological Survey management is charged with responsibility for

- providing sufficient resources (capital, manpower) for the project to meet its requirements and deliverables;
- providing contingency funds to address extreme events or occurrences; and
- taking the lead role during the absence of the ERCB/AGS TM Leader or TM Staff, and acting as the main liaison between the external emergency response agencies and the ERCB; this may involve retaining internal technical experts to ensure expertise remains available throughout the incident.

2.4 Emergency Response Group

The roles and responsibilities of the Emergency Response Group (ERG) include

- maintaining its capability to respond on a 24 hours/day, 7 days/week (24/7) basis; and
- alerting the upstream petroleum industry operators (through field staff) and the appropriate levels in the ERCB organization, of any changes in alert level.

2.5 Solicitor General Communication Centre

The Sheriffs' responsibilities at the Solicitor General (SOLGEN) Communication Centre include

- ensuring that the SOLGEN Communication Centre at Government Centre in Edmonton maintains its 24/7 capability;
- verifying that ERCB/AGS TM Leader or TM staff has acknowledged that messages have been received from the monitoring system and documenting who from ERCB/AGS is responding to the alarm and the time of acknowledgment;
- alerting the ERG of any displacement alert message (and a possible escalation of alert level) when ERCB/AGS TM Leader and TM Staff cannot be contacted; and
- alerting AEMA of any displacement alert message (and a possible escalation of alert level) when ERCB/AGS TM Leader, TM Staff and ERG cannot be contacted.

2.6 ERCB Information Technology Network Group

The Technical Support and Infrastructure Group will have responsibility (per the SLA) for

- conducting diagnostic checks of server accessibility by means of a ping script to confirm functionality, power supply and connectivity of supported server and network equipment (per Table 6), with frequency of diagnostic checks based on the requirements at the different alert levels (Table 7); and scheduling maintenance as required;
- notifying the ERCB/AGS TM Leader or TM Staff of any planned or unexpected system outages that may affect access to data or alarm notifications, with notification time based on the requirements at the different alert levels (Table 7);
- upgrading and regularly maintaining software and hardware equipment (per Table 6) to maintain a reliable system, notifying the ERCB/AGS TM Leader or TM Staff members of any upgrade and maintenance using notification time outlined in Table 7, with maintenance and upgrades scheduled only during alert level green;
- ensuring that parts identified in Table 6 are covered by third party agreement or are available in-house;
- contacting staff at the Provincial Building in Blairmore (by phone) and at FSIC (by phone) when access to TM computing infrastructure housed in their facilities is required, with notifications to be

made on a schedule deemed appropriate but as soon as possible to meet the maximum equipment downtime constraints outlined in Section 8 of the SLA;

- liaising with Internet provider (Shaw Cable) when Internet modem problems occur; and
- following the technical, administrative and operational responsibilities for the normal operation of the software and network equipment installed as outlined in the SLA (Section 8).

Table 7. Diagnostic checks frequencies and notification based on alert level.

Alert Level	Frequency ¹	Time ²
Green	Daily	Business hours
Yellow	Hourly	Business + Extended hours ³
Orange	Hourly	24 hours/day, 7 days/week basis
Red	Hourly	24 hours/day, 7 days/week basis

¹ System diagnostic

² System diagnostic check and notifications

³ Per 'Extended Support Handbook'

2.7 ERCB Information Technology Management Team

Energy Resources Conservation Board IT management is charged with responsibility for

- providing sufficient resources (capital, manpower) for the IT Network Group to meet its requirements and deliverables; and
- providing contingency funds to address extreme events or occurrences.

3 Responsibilities During Alert Level Green (Normal Operations)

Alert level green is defined as the normal operating state for the system, where there may be triggers on single sensors or where very slow overall movements occur within specified limits. At this alert level, the tasks outlined below are to be undertaken by the various groups within the ERCB/AGS TM Team to ensure that data are being reviewed and reported in a reliable and repeatable manner.

3.1 ERCB/AGS Turtle Mountain Leader

In addition to the roles identified in Section 2.1, the ERCB/AGS TM Leader will

- determine the roles and responsibilities of the ERCB/AGS TM Team in conjunction with the relevant participating groups, and review them regularly (once per year);
- conduct debriefing sessions for all groups participating in the ERCB/AGS TM Team following any decrease in alert level to green and after drilling exercises, to help identify lessons learned in the immediate post-response period;
- conduct training and response-drill sessions, on an annual basis, to ensure that project staff can perform their roles;
- make amendments to this Roles and Responsibilities Manual, as and when required, based on the conclusions drawn from debriefing sessions and drills, and on the modifications proposed by every group on the TM Team after their own internal debriefings and drills; and
- ensure that modifications are incorporated into relevant procedures in a reasonable timeframe, and help to disseminate the modifications to all designated groups and individuals.

3.2 Turtle Mountain Staff

If data trends are consistent and well within established threshold levels, TM staff will

- conduct **daily** system diagnostic checks (Monday to Friday) to confirm instrument functionality, power supply, radio links and hardware functionality, scheduling maintenance and repair of software and equipment supported by TM Staff, as required (per Table 5), and/or notifying Help Desk of any functionality problems found in software and network equipment supported by ERCB IT Network Group (Table 6); if an increase in alert level is not apparent, notification will occur only during regular business hours;
- notify Help Desk (during regular business hours) of any updates or upgrades made to software and hardware supported by TM Staff (per Table 5);
- prepare and distribute to the ERCB/AGS TM Leader, on the first day of each week, a **weekly** update with assessment of continuing risks and/or potential for elevation of alarm level; follow procedure outlined in Figure 3 and communication configuration in Figure 4a when no alarm has been generated; otherwise activate communication structure shown in Figure 4b in the event of an alarm;
- prepare annual data and interpretation summaries;
- review monitoring data to establish a baseline or typical value for seasonal fluctuation in displacement that will be used to define threshold levels and to detect nonseasonal displacements;
- evaluate and revise threshold levels on a semiannual basis, based on instrumentation data, conduct formal reviews in the first week of January and July of each calendar year, and recommend modification of threshold levels based on thorough analysis of the data and recommendations of external technical-assistance provider; and
- once alert level has been downgraded to green or after a drill, participate in debriefing sessions and help identify improvements to procedures.

3.3 Alberta Geological Survey Management

In addition to the roles identified in Section 2.3, the AGS Management Representative will, during alert level green,

- execute the Immediate Action Procedure if notified by the SOLGEN Communication Centre that the ERCB/AGS TM Leader or TM Staff members cannot be contacted:
 - a) Call the list in the following order:
 - i) ERCB/AGS TM Leader,
 - ii) TM Staff (on-duty),
 - iii) TM Staff (back up);
 - b) If contact is made, pass on the message and stop calling;
 - c) If no contact is made, try calling the above list 3 more times;
 - d) If, after calling the list 4 times, no contact is made, inform the ERG and AEMA of the displacement alert message; and
 - e) Repeat steps (a) through (c) until notification is received by someone on the first-call list.
- Take the lead role during the absence of the ERCB/AGS TM Leader or TM Staff and act as the main liaison between the external emergency response agencies and ERCB. This may involve retaining internal technical experts to ensure that expertise remains available throughout the incident.

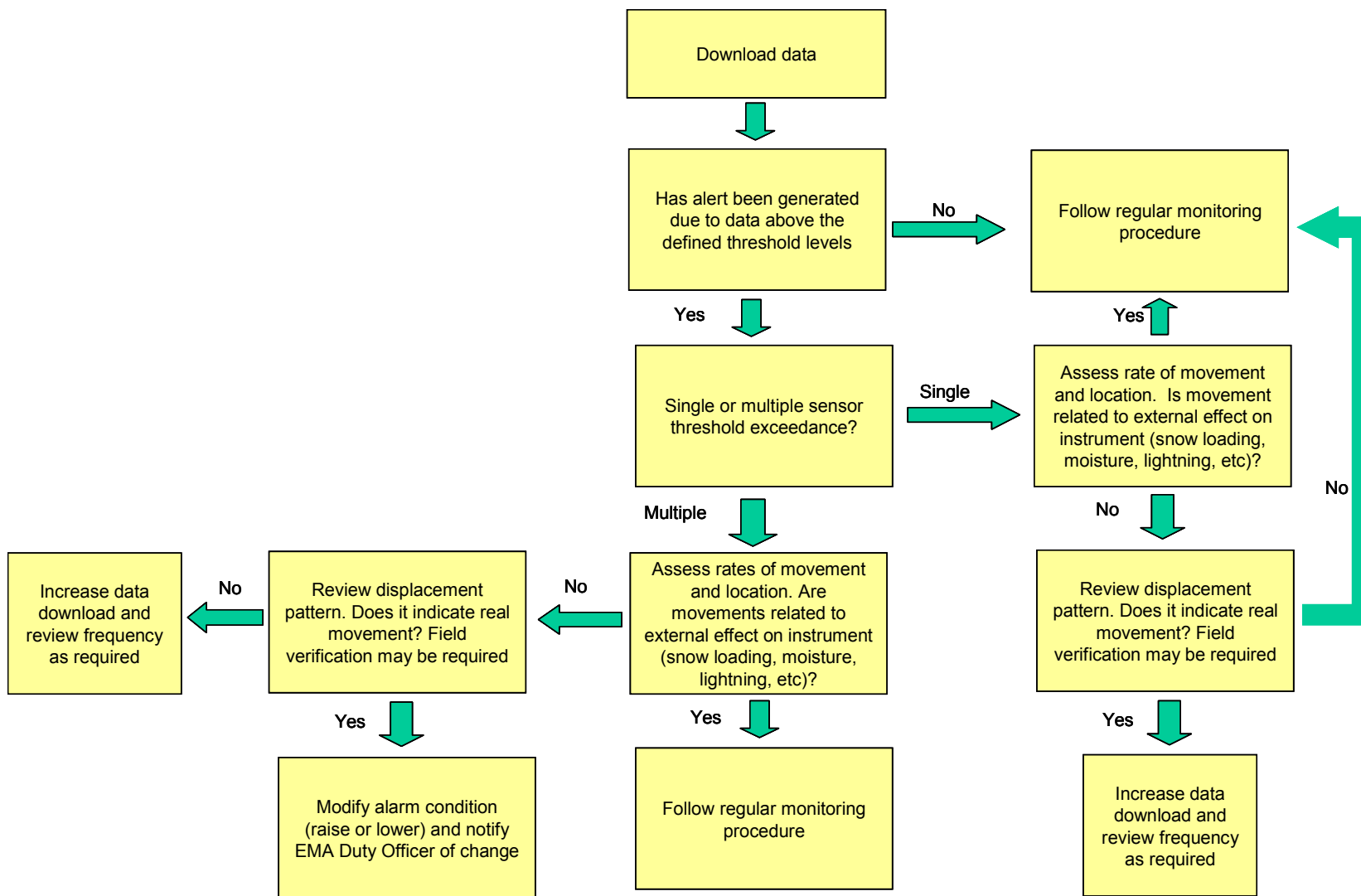


Figure 2. Recommended procedure for monitoring during threshold exceedance.

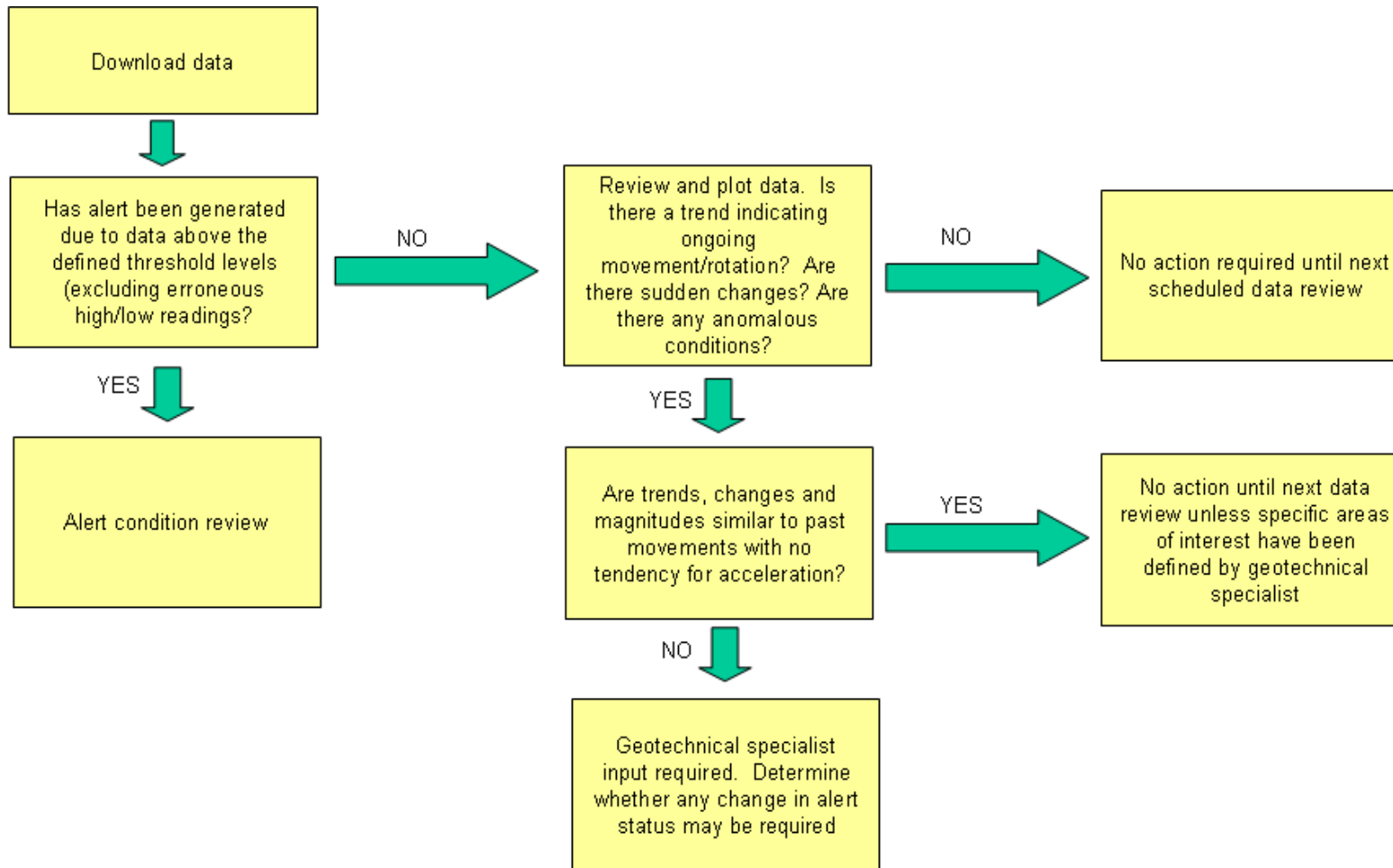


Figure 3. Recommended procedure for monitoring during regular monitoring.

3.4 Emergency Response Group

In addition to the roles identified in Section 2.4, the ERG will, during alert level green,

- execute the Immediate Action Procedure if notified by the SOLGEN Communication Centre that the ERCB/AGS TM Leader, TM Staff members or AGS Management Representative cannot be contacted:
 - a) Receive and record the message
 - b) Start calling the list in the following order:
 - i) ERCB/AGS TM Leader,
 - ii) TM Staff (on-duty),
 - iii) TM Staff (back up),
 - iv) AGS Management Representative (on-duty),
 - v) AGS Management Representative (back up);
 - c) If contact is made, pass on the message, stop calling and record on Activity Report;
 - d) If no contact is made, try calling the above list 3 more times;
 - e) If, after calling the first list 4 times, no contact is made, inform AEMA, the upstream petroleum industry operators (through field staff) and the appropriate levels in the ERCB organization of the displacement alert message; and
 - f) Repeat steps (a) through (e) until notification is received by someone on the first- or second-call list.
- determine their roles and responsibilities, and review them regularly (once per year);
- conduct internal debriefing sessions to help identify improvements to procedures;
- perform internal training sessions and drills to ensure that staff can perform their roles;
- propose modifications to this Roles and Responsibilities Manual as and when required, based on the conclusions drawn from internal debriefings sessions and drills; and
- implement new procedures in a reasonable timeframe.

3.5 SOLGEN Communication Centre

In addition to the roles identified in Section 2.5, the 24-hour security control centre will, during alert level green,

- execute the Immediate Action Procedure if a message has been received from the monitoring system:
 - a) Receive and record the message;
 - b) Start calling the list in the following order:
 - i) ERCB/AGS Leader,
 - ii) TM Staff (on-duty),
 - iii) TM Staff (back up),
 - iv) AGS Management Representative (on-duty),
 - v) AGS Management Representative (back up);
 - c) If contact is made, pass on the message, stop calling and record on Activity Report;
 - d) If no contact is made, try calling the above list 3 more times;
 - e) If, after calling the first list 4 times, no contact is made, start calling the ERG
 - f) If contact is made, pass on the message, stop calling and record on Activity Report;

- g) If no contact is made, try calling the second list 3 more times;
 - h) If, after calling the second-call list 4 times, no contact is made, alert AEMA of the displacement alert message; and
 - i) Repeat steps (a) through (h) until notification is received by someone on the first- or second-call list;
- determine their roles and responsibilities, and review them regularly (once per year);
 - conduct internal debriefing sessions to help identify improvements to procedures;
 - perform internal training sessions and drills to ensure that security staff can perform their roles;
 - propose modifications to this Roles and Responsibilities Manual as and when required, based on the conclusions drawn from internal debriefing sessions and drills; and
 - implement new procedures in a reasonable timeframe.

3.6 ERCB Information Technology Network Group

In addition to the roles identified in Section 2.6, the IT Network Group will, during alert level green,

- determine their roles and responsibilities, and review them regularly (once per year);
- perform enough training sessions and drills that everyone involved has the skills required to perform their roles; and
- propose modifications to this Roles and Responsibilities Manual as and when required, based on the conclusions drawn from internal debriefing sessions and drills, and implement them in a reasonable timeframe.

4 Responsibilities During Alert Level Yellow

Alert level yellow occurs when a systematic trend of movements begins to increase in velocity and the trend is deemed significant by the TM Staff, in conjunction with external project peer review. From this point on, the system will be monitored on a daily basis and the SOLGEN Communication Centre will no longer be required to acknowledge alarms (Figure 5).

4.1 ERCB/AGS Turtle Mountain Leader

In addition to the roles identified in Section 2.1, the ERCB/AGS TM Leader will, during alert level yellow,

- conduct periodic joint assessments and briefings to ensure a co-ordinated and considered response to new developments, escalations or changes in operational requirements, all decisions and key events being captured in the emergency-event log.

4.2 Turtle Mountain Staff

In addition to the roles identified in Section 2.2, the ERCB/AGS TM Staff will, during alert level yellow,

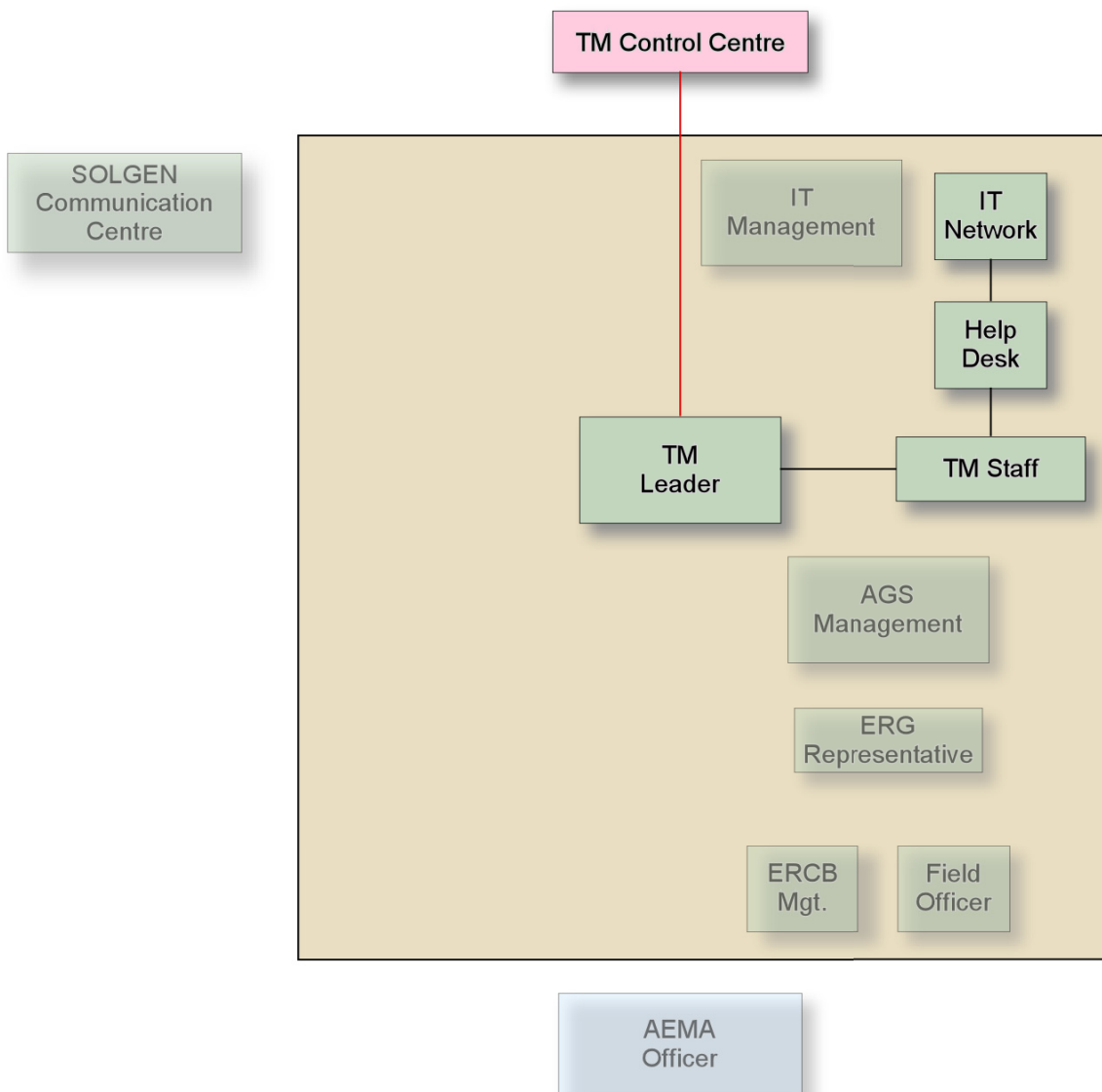
- conduct **hourly** system diagnostic checks (Monday to Friday) to confirm instrument functionality, power supply, radio links and hardware functionality, scheduling maintenance and repair of software and equipment supported by TM Staff, as required (per Table 5), and/or notifying Help Desk of any functionality problems found with software and network equipment supported by the IT Network Group (Table 6);

- produce communications or notifications during regular business hours and/or during the extended hours that the Help Desk is available (per “Extended Support Handbook”);
- prepare and distribute a **daily** update, with assessment of continuing risks and/or potential for upgrade/downgrade of alert level, to the ERCB/AGS TM Leader on the first hour of each day, following procedure outlined in Figure 3.

4.3 AGS Management

During alert level yellow, the AGS Management Representative will have the same responsibilities identified in Section 2.3.

a)



b)

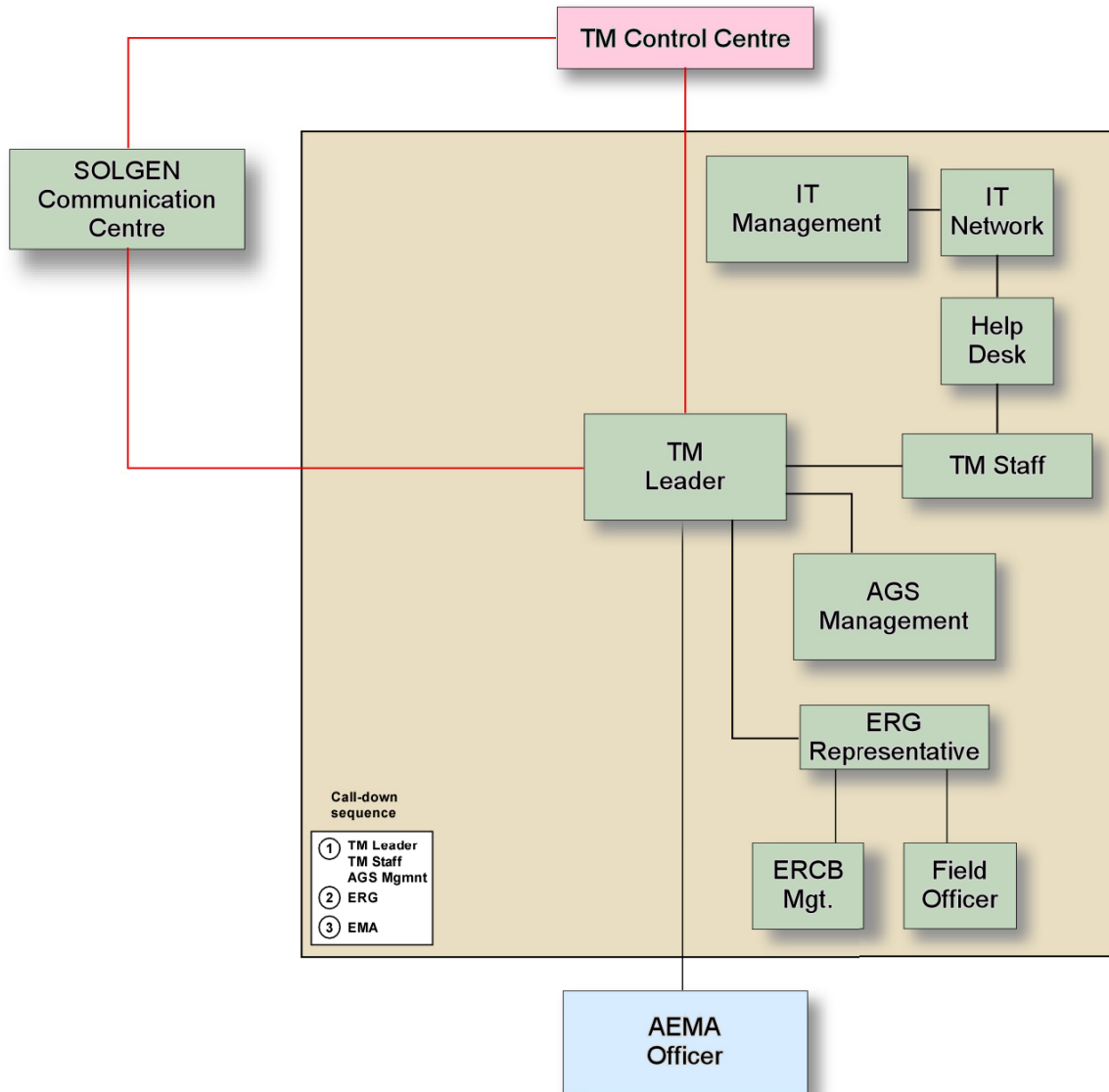


Figure 4. Incident command structure and function sequence for a) green alert level, and b) during alarm message generated at green alert level.

4.4 Emergency Response Group

During alert level yellow, the ERG will have the same responsibilities identified in Section 2.4.

4.5 ERCB IT Network Group

During alert level yellow, the IT Network Group will have the same responsibilities identified in Section 2.6.

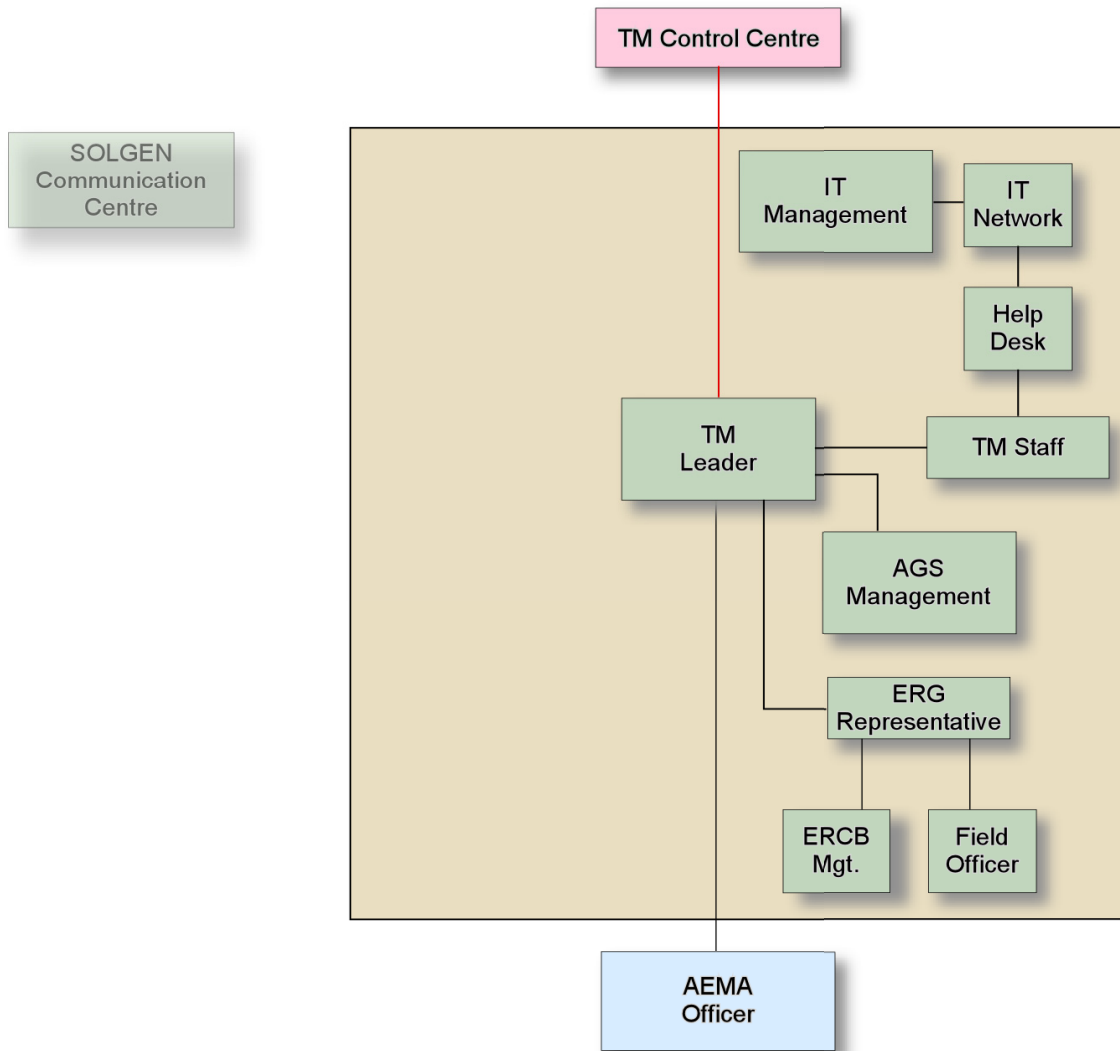


Figure 5. Incident command structure and function sequence for alert level yellow.

5 Responsibilities During Alert Level Orange

Alert level orange corresponds to a systematic acceleration of readings that suggest a rock-slope movement is leading up to the failure stage.

5.1 ERCB/AGS Turtle Mountain Leader

In addition to the roles identified in Section 2.1, the ERCB/AGS TM Leader will, during alert level orange,

- mobilize to the Crowsnest Pass with TM Staff members to serve as Subject Matter Expert for AEMA;
- conduct periodic joint assessments and briefings to ensure a co-ordinated and considered response to new developments, escalations or changes in operational requirements, all decisions and key events being captured in the emergency event log;

- retain external technical experts to ensure that expertise remains available throughout the incident (Figure 6);
- provide technical support to AEMA during decision-making throughout the incident, identifying the areas to which the media can be allowed access and a staging area overlooking the site from which the media can obtain pictures; be prepared to act as a source of technical information during the preparation of initial and subsequent news briefings by AEMA; act as the designated press officer from ERCB/AGS and attend news conferences if asked by AEMA;
- evaluate, in conjunction with ERG, whether it is necessary for NAV CANADA to issue a Notice to Airmen (NOTAM) advising pilots of restrictions in the airspace above the Emergency Zone or of closure of the airspace for a certain radius from the Emergency Zone.

5.2 Turtle Mountain Staff

In addition to the roles identified in Section 2.2, the ERCB/AGS TM Staff will, during alert level orange,

- mobilize to Turtle Mountain for visual verification of movements and act as Subject Matter Expert for AEMA, MCNP and emergency services; under no circumstances will access to the mountain on foot be allowed;
- conduct **hourly** system diagnostic checks to confirm instrument functionality, power supply, radio links and hardware functionality, scheduling maintenance and repairs of software and equipment supported by TM Staff, as required (per Table 5), and/or notifying on-duty IT Network person of any functionality problems found with software and network equipment supported by the IT Network Group (Table 6); 24/7 response capabilities must be maintained by the IT Network Team during alert levels orange and red;
- prepare and distribute an **hourly** update, with assessment of continuing risks and/or potential for upgrade/downgrade of alert level, to the ERCB/AGS TM Leader, following procedure outlined in Figure 3.

5.3 AGS Management

During alert level orange, the AGS Management Representative will have the same responsibilities identified in Section 2.3.

5.4 Emergency Response Group

In addition to the roles identified in Section 2.4, the ERG will, during alert level orange,

- assist the ERCB/AGS TM Leader, if necessary, in the request for a NOTAM (Notice to Airmen);

5.5 ERCB Information Technology Network Group

In addition to the roles identified in Section 2.6, the IT Network Group will, during alert level orange,

- mobilize to the Crowsnest Pass to provide on-site technical service; and
- ensure that IT personnel are available on a 24/7 basis to respond to issues with software and network equipment (per Table 6).

6 Responsibilities During Alert Level Red

Alert level red corresponds to the final stages in the development of a rockslide, where movements have accelerated beyond the point where slide is imminent and there is visual verification that a catastrophic failure is underway.

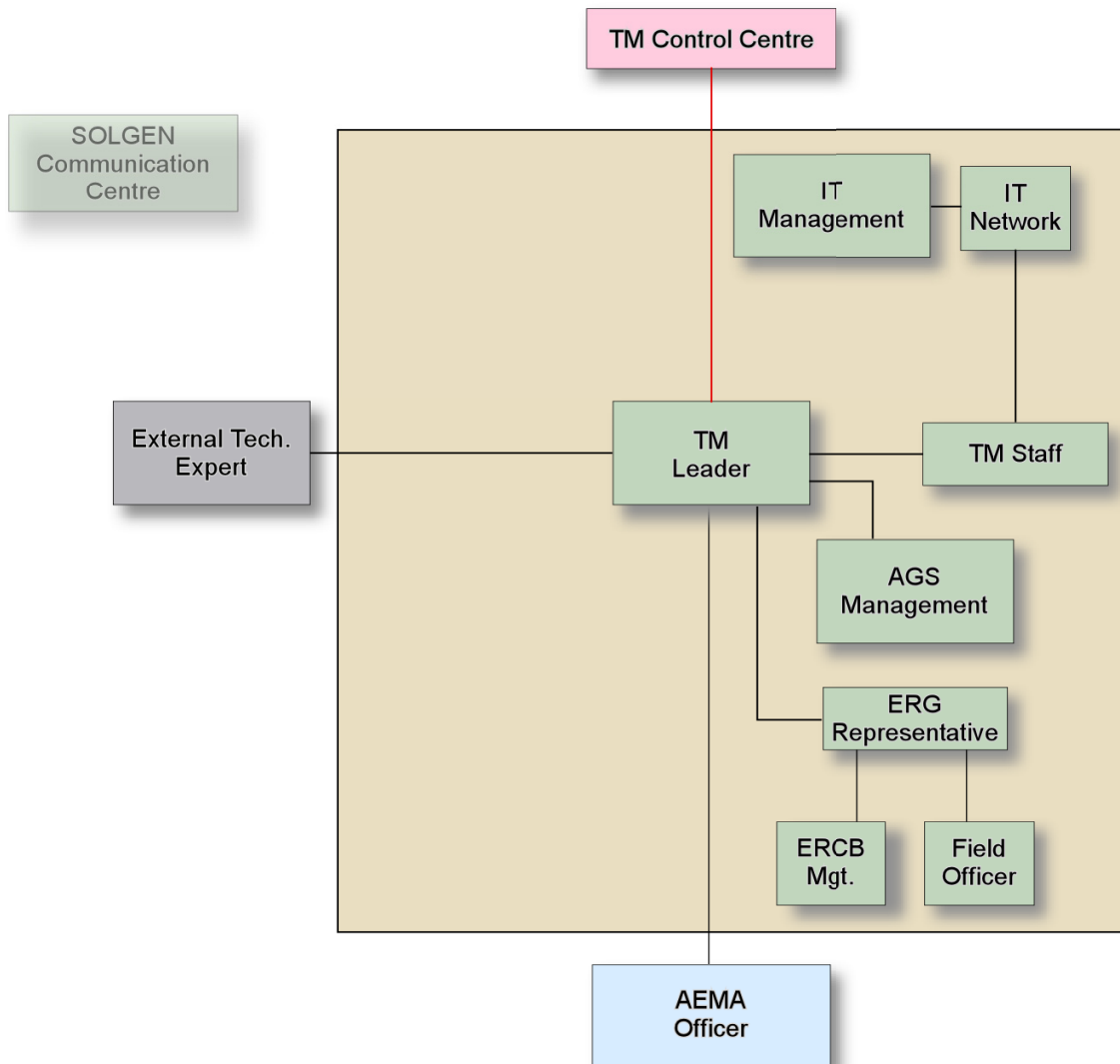


Figure 6. Incident command structure and function sequence for alert level orange.

6.1 ERCB/AGS Turtle Mountain Leader

In addition to the roles identified in Section 2.1, the ERCB/AGS TM Leader will, during alert level red,

- remain on-site to provide technical advice;
- conduct periodic joint assessments and briefings to ensure a co-ordinated and considered response to new developments, escalations or changes in operational requirements, all decisions and key events being captured in the emergency-event log;
- retain external technical experts to ensure that expertise remains available throughout the incident (Figure 7);
- communicate to AEMA the need for people to evacuate from the affected area;

- provide AEMA with technical data to determine extent of the evacuation area and location of cordons, shelter locations, and highway and railway blockades;
- inform AEMA of any need for an increase in the extent of the evacuation area, based on the most recent data analysis; and
- provide technical support to AEMA during decision-making throughout the incident, identifying the areas to which the media can be allowed access and a staging area overlooking the site from which the media can obtain pictures; be prepared to act as a source of technical information during the preparation of initial and subsequent news briefings by AEMA; act as the designated press officer from ERCB/AGS and attend news conferences if asked by AEMA.

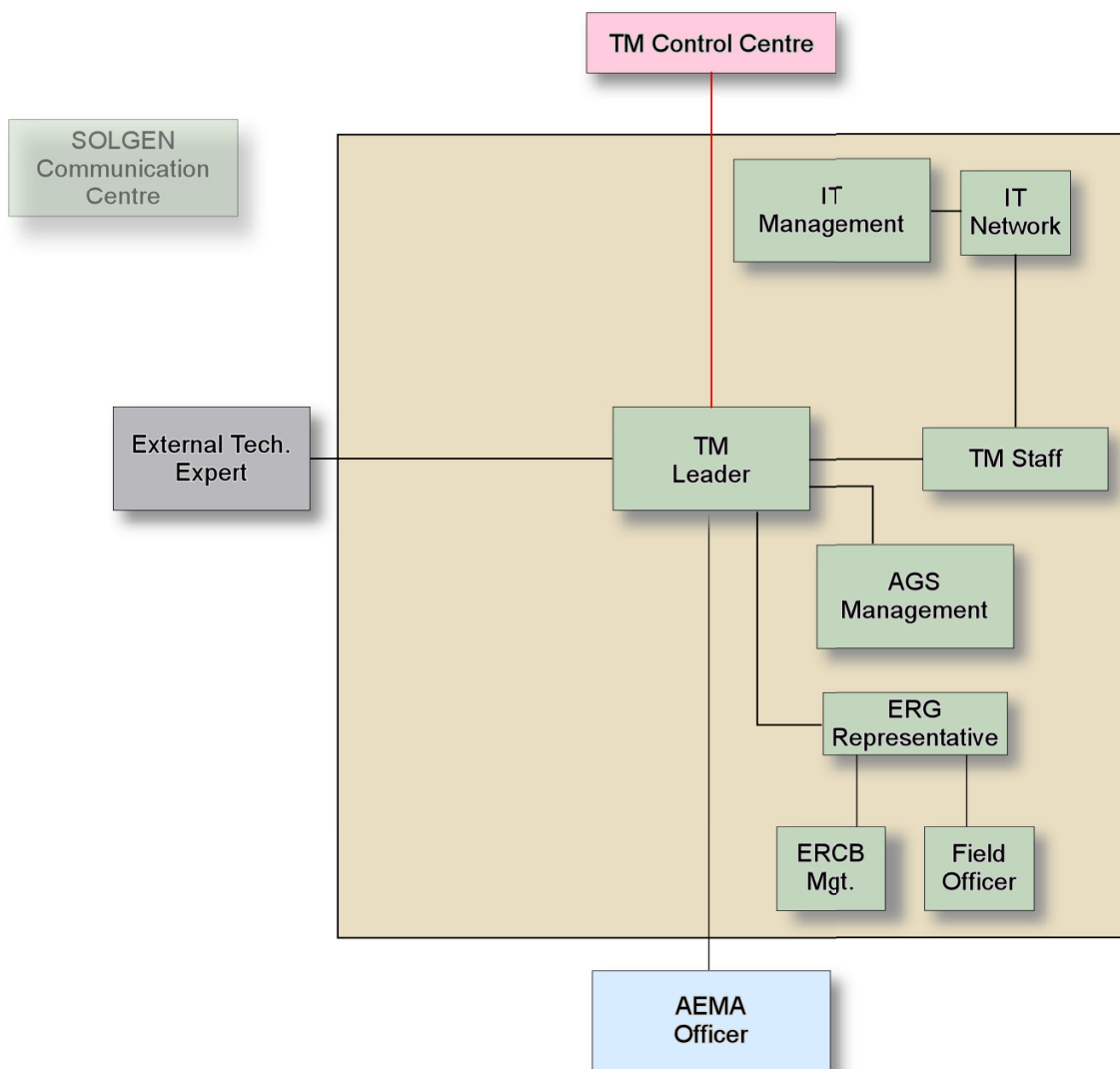


Figure 7. Incident command structure and function sequence for alert level red.

6.2 TM Staff

In addition to the roles identified in Section 2.2, the ERCB/AGS TM Staff will, during alert condition red,

- conduct **hourly** system diagnostic checks to confirm instrument functionality, power supply, radio links and hardware functionality, scheduling maintenance and repairs of software and equipment supported by TM Staff, as required (per Table 5), and/or notifying on-duty IT person of any functionality problems found with software and network equipment supported by the IT Network Group (Table 6); 24/7 response capabilities must be maintained by the IT Network Group during alert levels orange and red; and
- prepare and distribute an **hourly** update, with assessment of continuing risks and/or potential for downgrade of alarm level, to the ERCB/AGS TM Leader, following procedure outlined in Figure 3.

6.3 AGS Management

During alert level red, the AGS Management Representative will have the same responsibilities identified in Section 2.3.

6.4 Emergency Response Group

In addition to the roles identified in Section 2.4, the ERG will, during alert level red,

- assist the ERCB/AGS TM Leader, if necessary, in the request for a NOTAM (Notice to Airmen).

6.5 ERCB Information Technology Network Group

In addition to the roles identified in Section 2.6, the IT Network Group will, during alert level red,

- remain at Crowsnest Pass to provide on-site technical service; and
- ensure that IT personnel are available on a 24/7 basis to respond to issues with the software and network equipment (per Table 6).

7 Post Event

After complete collapse of the South Peak of Turtle Mountain, all instrumentation located on the mountain will be nonoperational and, from this point on, IT Network personnel will no longer be required (Figure 8).

7.1 ERCB/AGS Turtle Mountain Leader

In addition to the roles identified in Section 2.1, the ERCB/AGS TM Leader will, during the post-slide period,

- retain external technical experts to ensure that such expertise remains available during post-slide assessment/investigation;
- co-ordinate the visit of the post-slide investigation team to the site, taking into account the size of the team and the length of the investigation;
- advise interested parties of field investigation technical reports (facilitate exchange of technical information);
- provide continuity and follow-up for the technical lessons learned, by integrating, disseminating and archiving information for future research; and
- provide technical support to AEMA during decision-making after the incident, identifying areas to which the media can be allowed access and a staging area overlooking the site from which the media

can obtain pictures; be prepared to act as a source of technical information during the preparation of initial and subsequent news briefings by AEMA; act as the designated press officer from ERCB/AGS and attend news conferences if asked by AEMA.

7.2 TM Staff

In addition to the roles identified in Section 2.2, the ERCB/AGS TM Staff will, during the post-slide period,

- perform visual checks on the mountain to assess its stability; and
- carry out a natural-disaster investigation in the immediate post-slide period to identify technical lessons that might be applied in a similar situation in future.

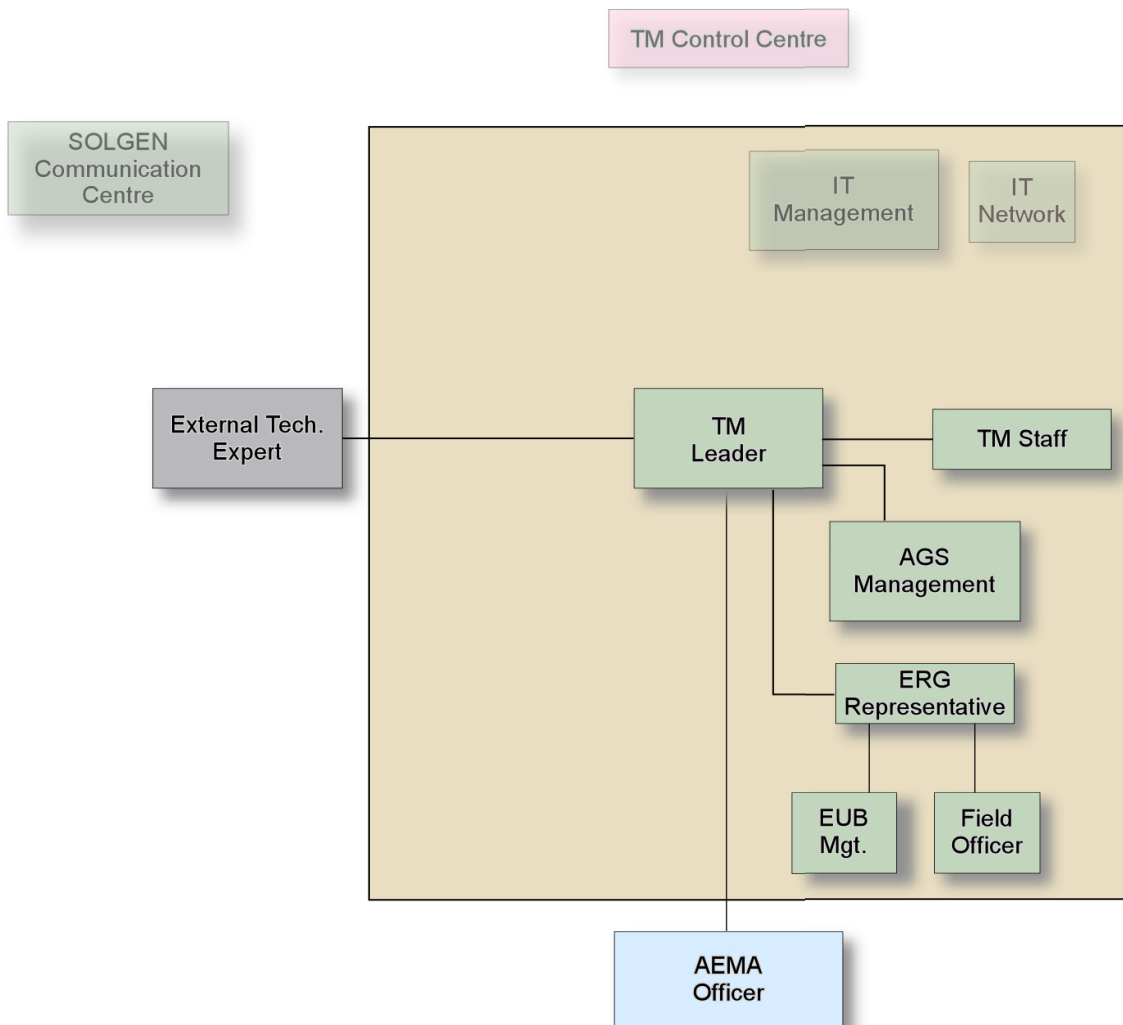


Figure 8. Incident command structure and function sequence for post-event level.

7.3 Emergency Response Group

During the post-slide period, the ERG will have the same responsibilities identified in Section 2.4.

8 Service Level Agreement

Alberta Geological Survey is also responsible for the maintenance of the instrumentation installed on Turtle Mountain. In order to fulfill this role, AGS teamed up with the ERCB IT Network Group. It was agreed that support of equipment would be provided as follows: AGS would service geotechnical monitoring equipment and communication elements (e.g., radios, antennas, data loggers, etc.) and IT Network Group would provide support for all networking equipment (e.g., router, server, modem, etc.). The required level of support varies among the data sources installed on the mountain, as well as with the alert levels (as described in Section 8.2).

8.1 Systems Summary

In considering the types of sensors most suitable for providing early warning of impending slope movements, they were grouped into the following data-stream categories:

- 1) **Primary data:** includes crackmeters, extensometers, tiltmeters, differential GPS, weather station, borehole piezometer and thermistors
 - Instruments are located on the west side of Turtle Mountain and connected by a wireless link to the Blairmore Provincial Building.
 - From there, data are relayed to FSIC via a second wireless link.
 - Data from these instruments are the primary diagnostic tool for interpreting any event on the mountain.
- 2) **Secondary data:** includes Electronic Distance Measurement system (EDM)
 - At present, the EDM system consists of 20 surveying prisms located on the east side of Turtle Mountain and a total station at the municipal pump house in Bellevue. After substantial testing, this equipment may be moved into the primary instrumentation group.
 - Data recorded by the total station are relayed to FSIC via a wireless link.
- 3) **Tertiary data:** includes mine spring-outflow measurements, and three recently installed differential Global Positioning System (dGPS) monitoring points, as well as images from the two web cameras installed at Turtle Mountain (one at the top of the mountain looking down, and one at the bottom of the mountain looking up).
 - The dGPS and minesite spring-water level and flow measurement systems are located on the east side of Turtle Mountain and connected by wireless link to the FSIC.
 - These processed data are then written to the server's SQL database.
 - The monitoring system at the FSIC was upgraded on March 28th, 2006. As part of this upgrade, the primary database server was replaced.
- 4) **Historical data:** all project data streams are written to the SQL database on the server at the FSIC; data older than 24 hours are considered historical data.

A detailed overview of the monitoring system on South Peak can be found in Moreno and Froese (2006).

8.2 Service Levels

The service levels are based on the data access requirements at the different alert levels. The method of access will also affect how the service level requirements are met (Table 8).

Link A: The primary data are monitored directly from the data loggers on Turtle Mountain using ATLAS web-based software (<http://www.slopeindicator.com/pdf/atlas-datasheet.pdf>). The data logger for the primary sensors on the west side of the mountain is accessed from the Internet connection to the Provincial Building in Blairmore (Figure 9).

Link B: All project data are stored in the server SQL database. The data are accessed over the Internet using a Visual Basic routine in EXCEL[®], which connects to the database via the Shaw Internet connection at the Provincial Building in Blairmore and the wireless link to the FSIC.

Link C: Web camera, dGPS and mine spring-water level and flow measurement systems (tertiary data) are located on the east side of Turtle Mountain and connected by wireless link to the FSIC. The data are accessed over the Internet via the Shaw Internet connection at the Blairmore Provincial Building and the wireless link to the FSIC.

The web camera was installed at the former seismic monitoring station at South Peak, destroyed by severe lightning in 2006, and it makes use of the existing wireless link to the FSIC. The three dGPS stations were installed at the Third Peak, Ridge and Pit seismic stations, and connected to the existing radio system.

9 Training and Exercises

Training and drills are critical to a successful emergency response. Training provides the necessary means for everyone involved to acquire the skills necessary to fulfil their roles during every level of alert. It may also provide ‘buy-in’ to the response process from both management and staff, which is essential for the success of any emergency protocol (Water Environment Federation, 2004). Two programs should be put in place to allow participants to practice their skills:

- Orientation sessions: These include basic instruction and explanation of the ERP and action plan procedures. Written tests may be used to ensure a minimum level of comprehension by the attendees.

Table 8. Maximum allowable downtime for software and network equipment associated with the various access data methods (links) at the different alert levels.

Link	Access Point	Data	Maximum Down Time ¹			
			Green	Yellow	Orange	Red
A	Blairmore (west side of Turtle Mountain)	Primary	3 days	1 day	1 Hour	1 Hour
B	FSIC ² (east side of Turtle Mountain)	Secondary/Historical Data	5 days	2 days	1 day	1 day
C	FSIC (east side of Turtle Mountain)	Tertiary	5 days	2 days	1 day	1 day

¹ Measured from the time that IT Network Group has acknowledged the call.

² Frank Slide Interpretive Centre

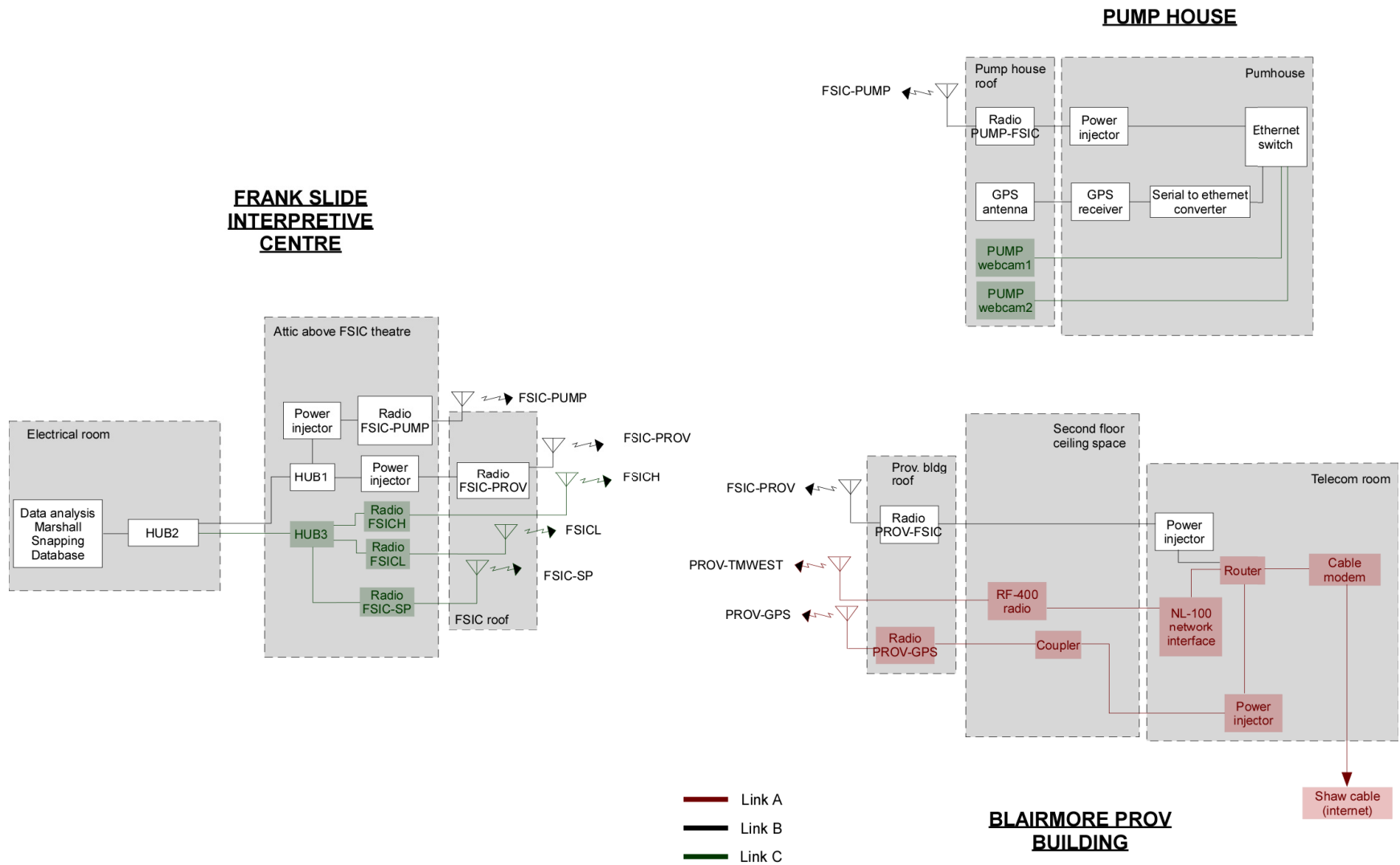


Figure 9. Wireless and wired Ethernet data access for the Turtle Mountain Monitoring Project.

- Table-top exercises: These are extremely helpful in testing emergency procedures and the effectiveness of the communication between personnel who will be acting at the different alert levels. Participants will be presented with a fabricated event and must discuss their potential responses. A director will facilitate the exercise and develop a credible scenario. After the exercise is complete, a review will be conducted to help identify lessons learned. The results will be shared with the participants. Strengths and weaknesses of the plan itself should also be identified and used to improve the overall plan.

Table-top exercises will be limited to testing internal procedures at ERCB/AGS related to the ERP for Turtle Mountain; thus, it will be restricted to testing the roles of ERCB/AGS employees. However, some drills performed by AEMA will require the active participation of the ERCB/AGS team to test the response of all the participating agencies in the ERP.

The following steps should be followed to ensure a successful table-top exercise (Water Environment Federation, 2004):

- 1) Conduct a needs assessment to determine a credible emergency scenario.
- 2) Define the scope of the exercise, including participants and ground rules.
- 3) Develop a statement of purpose and write the exercise directive that summarizes the exercise information and agenda.
- 4) Develop the exercise objectives against which the success of the exercise and participants will be evaluated.
- 5) Prepare the introductory narratives or background information for participants.
- 6) Develop major and detailed events in the form of a master scenario of events list that describes inputs of information and when these inputs occur during the exercise.
- 7) Prepare problem statements or messages and provide these to participants as the emergency scenario unfolds.

The TM Leader will be responsible for co-ordinating the drill test to evaluate the co-ordinated response between ERCB/AGS TM Team groups; however, each ERCB/AGS TM Team group will have ultimate responsibility for testing all operations within their own organization.

10 Debriefing

There is substantial value to be gained from a review of the response to any alert level by all participating personnel. This provides an opportunity to evaluate efficiency and gain experience, and also provides information to assist in ensuing inquiries.

During debriefing, the following should be considered (Plymouth City Council, 2005):

- Debriefing should start in the immediate post-response period.
- Everyone involved should be afforded the opportunity to contribute to the debriefing
- Additional sessions should be held as deemed necessary.

Facts emerging from debriefings should be documented and problems identified. Lessons learned should be shared with all who may have to respond to other major incidents. It is essential that a process is agreed upon in which all lessons learned are identified and, where considered appropriate, incorporated into relevant procedures within an agreed timeframe.

The debriefing process might culminate in a multiagency forum, which includes all responders involved in the incident and any other personnel deemed necessary.

11 References

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Appendix 1 – Acronyms and Abbreviations

24/7	24 hours/day, 7 days/week
AEMA	Alberta Emergency Management Agency
AGS	Alberta Geological Survey
CPR	Canadian Pacific Railway
dGPS	Differential Global Positioning System
EDM	Electronic Distance Measurement
EOC	Emergency Operations Centre
ERCB	Energy Resources Conservation Board
ERG	Emergency Response Group
ERP	Emergency Response Protocol
FSIC	Frank Slide Interpretive Centre
GOA	Government of Alberta
GPS	Global Positioning System
IA	Immediate Action
IT	Information Technology
MCNP	Municipality of Crowsnest Pass
NOTAM	Notice to Airmen
RCMP	Royal Canadian Mounted Police
SLA	Service Level Agreement
SME	Subject Matter Expert
SOLGEN	Solicitor General
TM	Turtle Mountain
TMMS	Turtle Mountain Monitoring System