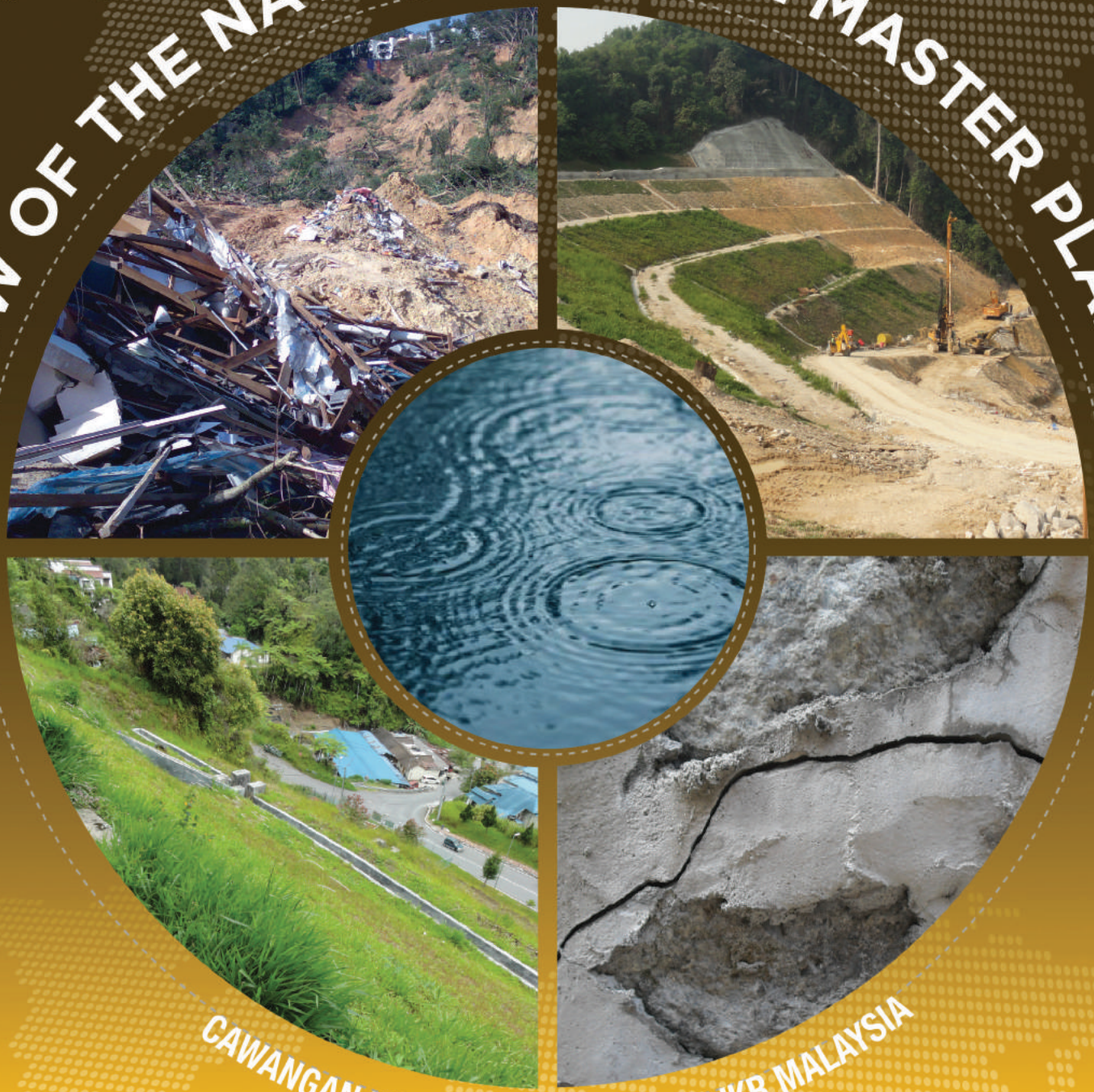
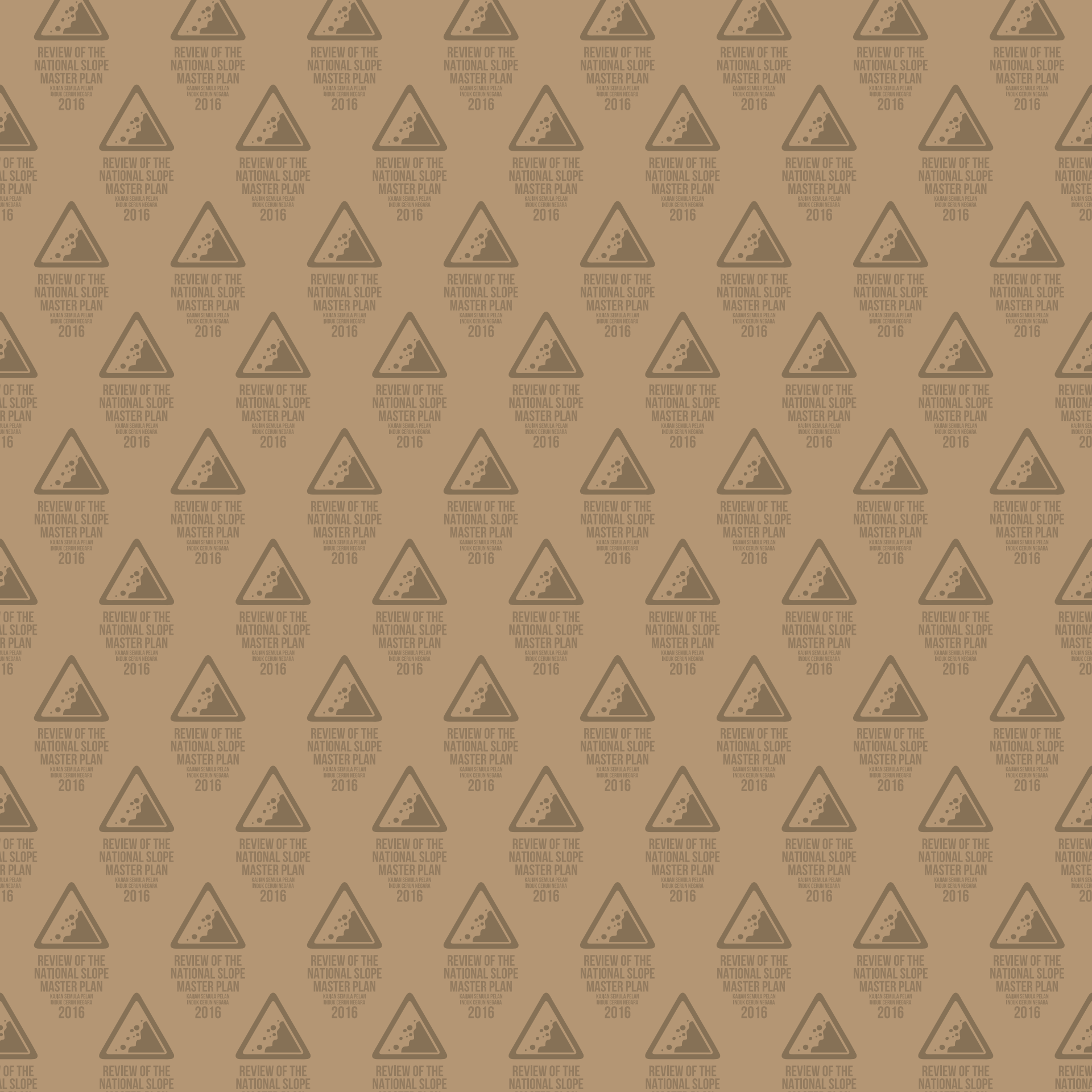
Cawangan Kejuruteraan Cerun
JKR Malaysia

REVIEW OF THE NATIONAL SLOPE MASTER PLAN 2016



CAWANGAN KEJURUTERAAN CERUN JKR MALAYSIA


REVIEW OF THE
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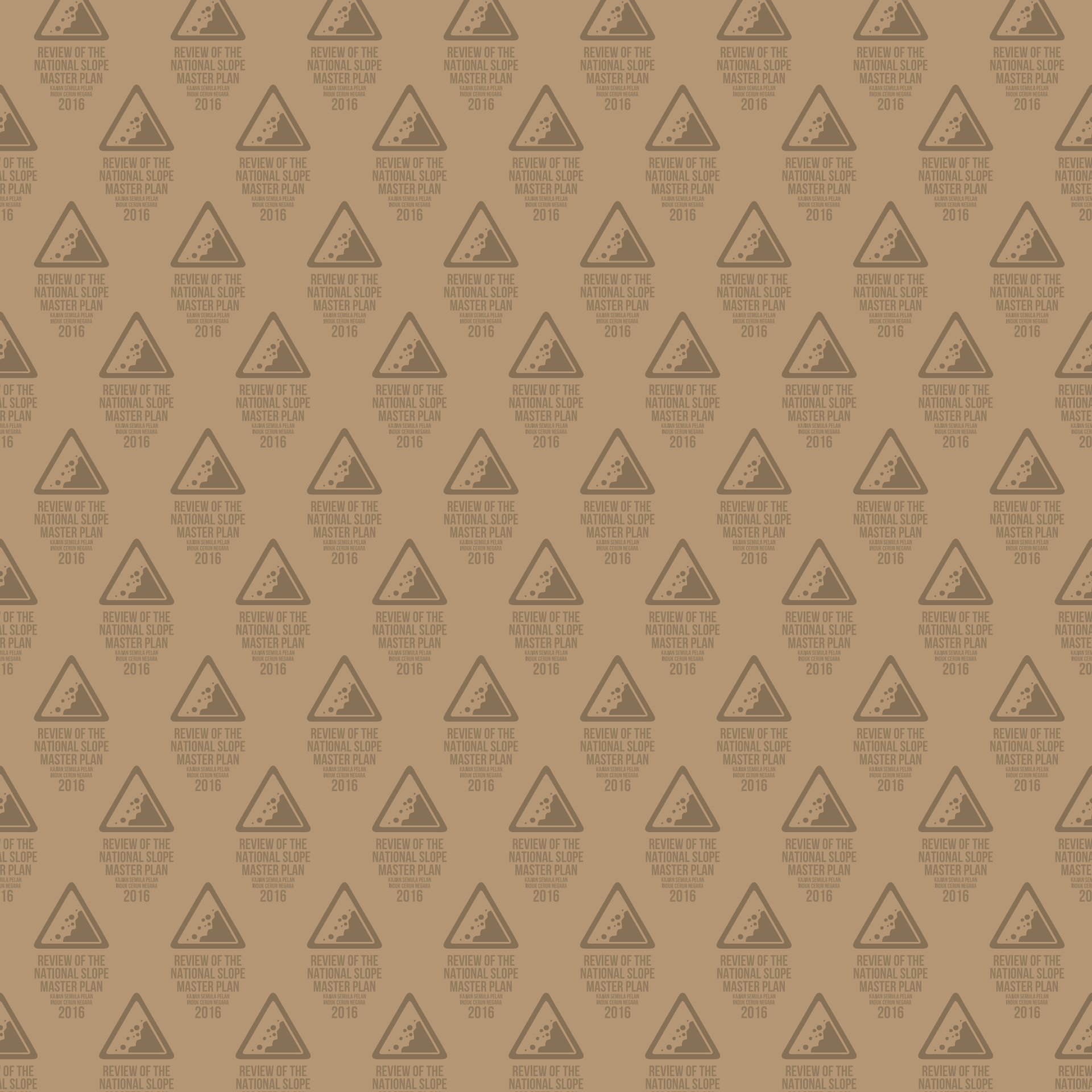
REVIEW OF THE
NATIONAL SLOPE
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REVIEW OF THE NATIONAL SLOPE MASTER PLAN 2016

KAJIAN SEMULA PELAN INDUK CERUN NEGARA 2016

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FOREWARD

NEED FOR A PLAN

The National Slope Master Plan Study, carried out between 2006 to 2008, was one of great significance in that it was the first guiding document that provided direction in managing the nation's numerous slopes and addressing one of the major geohazard disasters afflicting communities throughout the country.

The spectre of landslides is not new in Malaysia. Since the first recorded landslide in Ringlet, Cameron Highlands in 1961 which claimed six lives, the history of Malaysia has been riddled with catastrophic events, including a typhoon-induced mudslide which killed 300 people in 1996 and more recently, an earthquake-triggered rockfall in Kundasang, Sabah which shook the world with vivid images of tourists and local communities who fell victim to the tragedy.

When the landslide disasters reached a scale that encompassed heavy economic losses and productivity as well as lives, the Government had to take action. After the Bukit Lanjan rockfall in 2003, which virtually brought a transportation artery in the Klang Valley conurbation to a grinding halt, the Cabinet issued a directive to the Public Works Department (JKR) to set up a new branch dedicated to slope management and control. Hence, the Slope Engineering Branch or *Cawangan Kejuruteraan Cerun* was formed in 2004.

JKR ACTION

One of the first steps the Branch took after its inception was to commission a study to craft a 15-year roadmap on approaching slope management in a holistic manner. By then, the Government had realised that landslides were no longer a technical or engineering problem, but a human one which affected them physically, psychologically, financially, and socially.

Thus the National Slope Master Plan came about to address landslides and slope issues from the perspective of ten components, namely Policy and Institutional Framework; Loss Assessment; Early Warning and Real-Time Monitoring Systems; Hazard Mapping and Assessment; Information Collection, Interpretation, Dissemination and Archiving; Training; Public Awareness and Education; Loss Reduction Measures; Emergency Preparedness, Response and Recovery; and Research and Development.

It was the first master plan of its kind in the world, and held great promise of creating changes among policy makers, planners, implementers and the general public, particularly for those living in hillside and landslide-prone areas.

WHAT'S NEXT

Five years after its completion, there is evidence of the Master Plan's impact at the local, state, and federal government levels as well as among the public at large. A number of local authorities have established its own slope units dedicated to managing slopes, while guidelines and slope development approval processes at the state level have been either newly set up or improved and made more stringent. The media has changed its coverage of slopes from disaster-only to more on prevention and mitigation. In the meantime, there is growing awareness among hillside homeowners about maintaining and repairing slopes.

Having said this, there is still much left to do. Implementation of the strategies over the past five years has been challenging, and there is a need for more awareness among the key relevant agencies. For these reasons and the fact that prevailing conditions affecting the slope sector change over time, JKR mandated that the National Slope Master Plan be revised and updated every five years to ensure that its strategies and action plans are still relevant and applicable. In this way, the Master Plan is a 'living document' to ensure that it caters to the needs and requirements of the slope industry sector, stakeholders, and the public at large.

The pages to follow present a revised version of the plan, the National Slope Master Plan Revision 2016, which is not only timely but necessary for JKR's guiding principle of keeping slopes safe in order to save lives for the years leading up to 2023 and beyond.

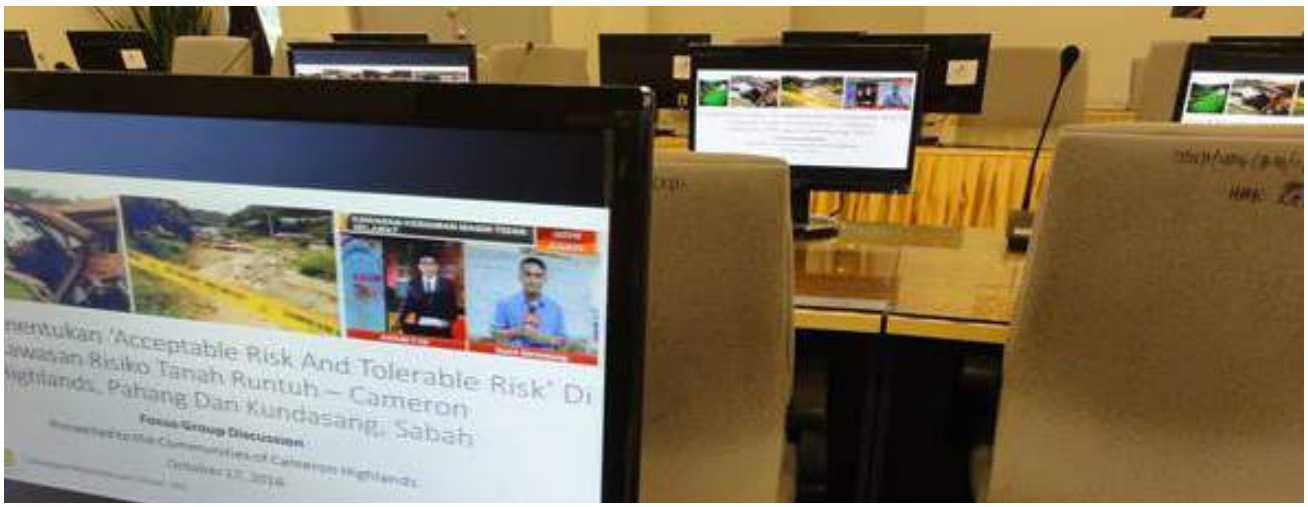

BACKGROUND

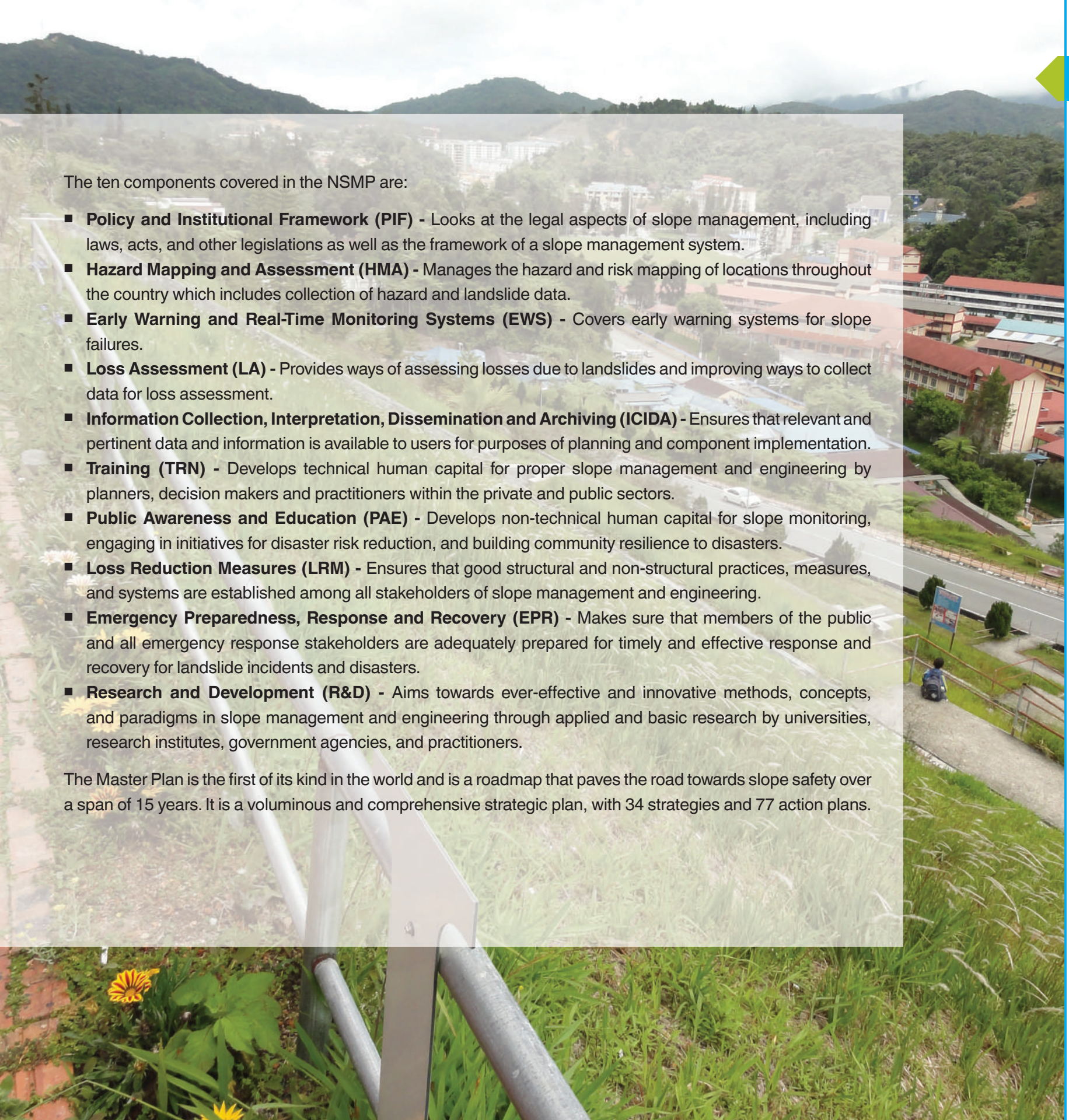
- 2009 NATIONAL SLOPE MASTER PLAN
- REVIEW OF THE NATIONAL SLOPE MASTER PLAN 2016
- WHAT'S NEW IN THE 2016 REVIEW?

2009
NATIONAL SLOPE MASTER PLAN

The National Slope Master Plan (NSMP) is a 15-year roadmap outlining strategies, action plans and measures to be taken to reduce losses in lives and properties throughout the country. The event that triggered the inception of the NSMP was the 2003 Bukit Lanjan landslide, which did not result in any fatalities but had an enormous economic impact—almost three-quarters of a billion ringgit. This watershed event led to a Cabinet decision to establish an engineering branch within JKR dedicated to slope safety and management. Thus, the Slope Engineering Branch or *Cawangan Kejuruteraan Cerun (CKC)* was formed in 2004.

Upon establishment, one of its first endeavours was the formulation of a strategic plan to manage slopes, private and public, within the entire country. From 2006 to 2008, a study comprising ten teams for various components of the NSMP was carried out, and the resultant document provided direction for the various aspects of slope management.





The ten components covered in the NSMP are:

- **Policy and Institutional Framework (PIF) -** Looks at the legal aspects of slope management, including laws, acts, and other legislations as well as the framework of a slope management system.
- **Hazard Mapping and Assessment (HMA) -** Manages the hazard and risk mapping of locations throughout the country which includes collection of hazard and landslide data.
- **Early Warning and Real-Time Monitoring Systems (EWS) -** Covers early warning systems for slope failures.
- **Loss Assessment (LA) -** Provides ways of assessing losses due to landslides and improving ways to collect data for loss assessment.
- **Information Collection, Interpretation, Dissemination and Archiving (ICIDA) -** Ensures that relevant and pertinent data and information is available to users for purposes of planning and component implementation.
- **Training (TRN) -** Develops technical human capital for proper slope management and engineering by planners, decision makers and practitioners within the private and public sectors.
- **Public Awareness and Education (PAE) -** Develops non-technical human capital for slope monitoring, engaging in initiatives for disaster risk reduction, and building community resilience to disasters.
- **Loss Reduction Measures (LRM) -** Ensures that good structural and non-structural practices, measures, and systems are established among all stakeholders of slope management and engineering.
- **Emergency Preparedness, Response and Recovery (EPR) -** Makes sure that members of the public and all emergency response stakeholders are adequately prepared for timely and effective response and recovery for landslide incidents and disasters.
- **Research and Development (R&D) -** Aims towards ever-effective and innovative methods, concepts, and paradigms in slope management and engineering through applied and basic research by universities, research institutes, government agencies, and practitioners.

The Master Plan is the first of its kind in the world and is a roadmap that paves the road towards slope safety over a span of 15 years. It is a voluminous and comprehensive strategic plan, with 34 strategies and 77 action plans.


National Slope Master Plan (NSMP)
Policy & Institutional Framework
Hazard Mapping & Assessment
Early Warning and Real-Time Monitoring Systems
Loss Assessment
Information Collection, Interpretation, Dissemination and Archiving
Training
Public Awareness & Education
Loss Reduction Measures
Emergency Preparedness, Response and Recovery
Research & Development

Policy and Institutional Framework (PIF)
Looks at the legal aspect of slope management including laws, acts and other legislations as well as the framework of a slope management system

Hazard Mapping and Assessment (HMA)
Manages the hazard and risk mapping of locations throughout the country which includes collection of hazard and landslide data

Early Warning System (EWS)
Covers early warning systems for slope failures

Loss Assessment (LA)
Provides ways of assessing losses due to landslides and improving ways to collect data for loss assessment

Information Collection, Interpretation, Dissemination and Archiving (ICIDA)
Ensures that relevant and pertinent data and information is available to users for purposes of planning and component implementation

Loss Reduction Measures (LRM)
Ensures that good structural and non-structural practices, measures and systems are established among all stakeholders of slope management and engineering

Public Awareness and Education (PAE)
Develops non-technical human capital for slope monitoring, engaging in initiatives for disaster risk reduction and building community resilience to disasters

Training (TRN)
Develops human capital for proper slope management and engineering by planners, decision makers and practitioners within the private and public

Emergency Preparedness, Response and Recovery (EPR)
Makes sure that members of the public and all emergency response stakeholders are adequately prepared for timely and effective response and recovery from landslide incidents and disasters

Research and Development (R&D)
Aims towards ever-effective and innovative methods, concepts and paradigms in slope management and engineering through applied and basic research by universities, research institutes, government agencies and practitioners

REVIEW OF THE **NATIONAL SLOPE MASTER PLAN 2016**

In line with the promise of keeping the master plan a 'living document', the Master Plan was revised to ensure that the plan is aligned with the current prevailing social, economic, technological, and industry trends as well as paradigms within the nation. This involved four major stakeholder meetings with JKR, agencies and institutions in Sabah and Peninsular Malaysia, the R&D community throughout the country as well as a number of visits to various agencies for detailed discussions. This entailed getting comments and feedback from 48 agencies and over 160 participants.

The Master Plan also includes a set of resolutions from a slope management seminar hosted by the Construction Industry Development Board (CIDB) and the Ministry of Housing and Local Government (KPKT) in conjunction with JKR in 2014. Contributed by a panel of senior agency officials and practitioners, these resolutions—which were drafted two years prior to the review of this Master Plan—still holds true and echoes the same comments and suggestions raised during the stakeholders' sessions in 2016.

And finally, to truly be a document for an all-inclusive society, comments from residents living in hillside communities were considered into the revision of the Plan, as it caters not only to the implementing agencies but will service the public and communities who normally become the final end-users of the slopes that are built around them.

The result is a more inclusive and condensed edition with an emphasis on implementation of action plans by the stakeholders. Owing to the comprehensiveness of the scope, breadth and depth of the 2009 Master Plan Study, many of the strategies and action plans of the previous Plan were retained, with modifications made for improving ease of implementation. The changes ranged from 8% of action plans that were merged for conciseness and 25% of action plans being left wholly intact as originally written in the 2009 Master Plan.

Strategies by Thrust

As in the previous Master Plan, the strategies and action plans by the ten components shall be grouped by components, but to make it easier for stakeholders to understand and implement, the strategies and action plans shall also be presented as 'thrusts'. Thrusts are priority areas that have to be carried out to attain the slope management goals by 2023. There are five thrusts, namely Assessing Landslide Risk, Investing in Risk Reduction, Promoting Good Governance, Preparing for Response and Recovery as well as Spurring Innovation.

STRATEGIES BY COMPONENTS

COMPONENT	STRATEGIC THRUST
Policies and Institutional framework (PIF)	Develop effective policy and institutional frameworks for landslide risk reduction, mitigation and disaster preparedness
Hazard Mapping and Assessment (HMA)	Develop a framework to establish an inventory of susceptible areas and different types of landslide hazard/risk mapping and assessment at a scale useful for planning and decision making.
Early Warning and Real-Time Monitoring System (EWS)	Conduct ongoing monitoring and provide warning on slope hazards to relevant authorities to initate timely preventive measures and reduce the damage caused by landslides.
Loss Assessment (LA)	Compile, maintain and eveluate information on the various types of losses resulting from landslides to guide mitigation activities and track progress in reducing losses.

STRATEGIES BY THRUST

The 2016 Review of the Master Plan Focuses on Implementation of the 2009 Master Plan

By and large, the strategies of the 2009 Master Plan have been left intact, and the modifications made are for easier implementation by CKC and the relevant agencies. These revised strategies and action plans are recommendations for CKC and the implementing agencies, which shall review the revised strategies on year-by-year basis and execute as and when suitable.

Change in Component Name from 'Loss Reduction Measures' to 'Landslide Prevention Measures'

The meaning of the term 'loss reduction measures' is ambiguous and has led to different interpretations by stakeholders. Furthermore, loss reduction is a principle which underscores ALL the action plans highlighted in the NSMP, including policy and institutional framework, hazard mapping and assessment, early warning system, and all of the other components. Loss reduction measures is more of a philosophy that underpins everything in the NSMP.

For all intents and purposes, this component was meant to identify, define and promote best practices in slope planning, design, construction and engineering as well as maintenance.

Thus, the name of this component was changed to 'Landslide Prevention Measures', which more accurately describes the range of activities this component covers such as best slope practices in planning, design, construction and engineering, as well as physical slope works such as retrofitting.

Focus of the National Slope Master Plan from Disaster Risk Reduction to Quality of Life

The focus of the 2009 NSMP and the mindset of the nation with regards to slope management have been confined to the realm of disasters only. True, landslides have long been regarded as a natural or man-made disaster, but such events are far rarer than the chronic but minor landslides or landslips in urban areas.

Ongoing concerns over public and personal safety among residents in hillside neighbourhoods or near slope developments make this issue a matter of wellbeing (safer cities and neighbourhoods). In this way, the definition of slope failures and landslides can be broadened beyond the confines of 'disaster'. Peace

of mind, quality of life, and sense of safety in one's home are also indicators of wellbeing, which is one of the performance indicators mentioned in the Eleventh Malaysia Plan. Factors affecting this social indicator are examined in this revision of the NSMP.

Inclusion of a New Component 'Sustainable Slope Practices'

In line with the Eleventh Malaysia Plan and global trend is sustainable urban development, the NSMP includes sustainability in slope construction and management. Although the greening of slope is an attribute of sustainability, it goes wider than this to include contribution to economic growth and employment, cultural heritage, health and safety.

Setup of a Working Committee

The roll-out and implementation of strategies for the previous Master Plan hinged on the set-up of an independent slope agency called the Slope Engineering Agency (SEA). As this has not materialised to date, an alternative yet equally effective implementation method had to be established. The genesis of a viable implementation structure came from discussions with CKC and from a briefing by the Construction Industry Development Board on their own master plan, the Construction Industry Transformation Plan (CITP). From CKC, it was discovered that following up with stakeholders on the implementation of the strategies was difficult. The responsibility of implementation, monitoring and tracking fell upon a few staffers within CKC, who had other main functions and responsibilities to do. A dedicated team within CKC and a way of sharing the responsibility of implementation was needed.

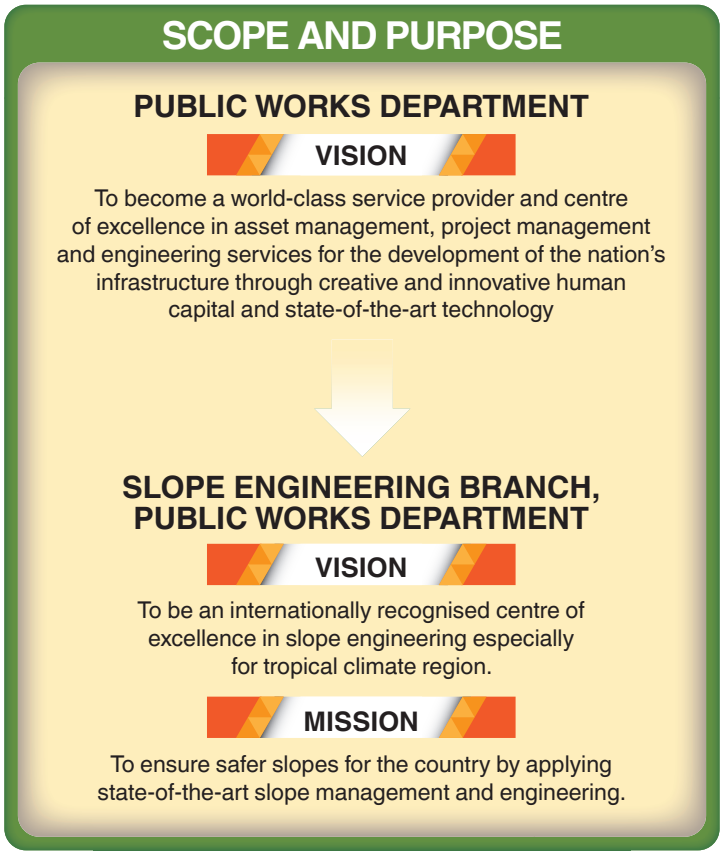
From the Construction Industry Development Board, it was learned that working committees consisting of practitioners, government officers, and other members provided a multi-stakeholder approach to strategy implementation were the drivers of the CITP implementation. Thus, a similar working committee structure was adopted for the NSMP implementation. These committees shall also set the targets for each thrust as the results from the NSMP depended heavily on the funds it received, as evidenced by the experience of the 2009 NSMP whose targets were not fully met due to lack of funds.

Calendar of Action Plans by Year

One of the wishlist items of CKC was a clear plan for implementation. A year-to-year implementation plan is provided in this Master Plan.

SCOPE, OUTCOME AND GOALS OF THE REVISED NSMP

The scope and purpose, outcome, goals and thrusts of the Review of the NSMP 2016 remains the same as the 2009 edition, except with a bit more elaboration.



Scope and Purpose of The NSMP

The present framework will apply to the risk of small-scale and large-scale, frequent and infrequent, sudden and slow-onset landslides caused by natural or manmade hazards as well as related environmental, technological and biological hazards and risks. It aims to guide the slope management and disaster risk at all levels as well as within and across all sectors, private and public.

Expected Outcome

The substantial reduction of landslide risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, business, communities and countries.

Goal

Prevent new and reduce existing landslide risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to landslides, increase preparedness for response and recovery, increase sustainability and thus strengthen resilience.

Five Thrusts

The strategies and action plans of the revised NSMP are grouped by priorities or thrusts. These thrusts were inspired by the Sendai Framework, which focuses on actions to take to reduce disaster risk.

Assessing Landslide Risks

Identification of hazardous and risky areas throughout the country will enable better land use decisions and early action towards mitigation and preparedness. It is important to understand and assess landslide hazards and risks in all its aspects of vulnerability, capacity, exposure of persons and properties, hazard characteristics, and the environment.

Investing in Risk Reduction

Encourage public and private investment in disaster risk reduction and social wellbeing through structural and non-structural measures necessary for economic and social resilience of persons, communities, assets, and the environment. Such measures should be cost-effective and instrumental in saving lives, prevent and reduce public and individual financial losses, provide peace of mind and promote social wellbeing, as well as ensure effective recovery and rehabilitation.

Promoting Good Governance

Strengthen good governance in disaster risk and industry practices for management of slopes in all sectors as well as ensuring the coherence of national and local frameworks of laws, regulations and public policies, which through clear definition of roles and responsibilities, guide, encourage and incentivise the public and private sectors to take action and address disaster risk share responsibilities and cost of slope management. This includes professionalism, legal and institutional improvement and coordination, assessing losses, data sharing, and training.

Preparing for Response and Recovery

Ensure more effective response and capacities for effective recovery, rehabilitation and reconstruction.

Spurring Innovation

Align research and development direction with slope industry needs and encourage creativity and innovation for slope management and engineering solutions that can be adopted by practitioners for application in the field.

REVIEW OF THE NSMP 2016 **FRAMEWORK**

SCOPE AND PURPOSE

The present framework shall apply to the risk of small-scale and large-scale, frequent and infrequent, sudden and slow-onset landslides, caused by natural or manmade hazards as well as related environmental, technological and biological hazards and risks. It aims to guide the slope management and disaster risk at all levels as well as within and across all sectors, private and public.

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THRUSTS FOR ACTION

THRUST 1	THRUST 2	THRUST 3	THRUST 4	THRUST 5
Assessing landslide risk	Investing in risk reduction	Promoting good governance	Preparing for response and recovery	Spurring innovation

MALAYSIAN SLOPE MANAGEMENT INDUSTRY

- MALAYSIAN SLOPE MANAGEMENT INDUSTRY—THE PAST FIVE YEARS TO NOW
- ACHIEVEMENTS - THE SLOPE MANAGEMENT INDUSTRY NOW... AT A GLANCE

MALAYSIAN SLOPE MANAGEMENT INDUSTRY **THE PAST FIVE YEARS TO NOW**

When the 2009 NSMP was released, the slope scenario then was in a different situation than it is now. The infamous Bukit Antarabangsa landslide disaster had just occurred, residents and victims clashed with search and rescue personnel and emergency first responders over the way the landslide disaster management operation was being carried out, and substandard geotechnical engineering practices of the past were just beginning to be discovered—not only within Bukit Antarabangsa and the greater area of Ulu Klang—but on slopes throughout the country as well. Amidst this turmoil, the release of the NSMP to set the direction of the slope industry in order was timely.

Since then, the slope sector has changed, dramatically from some perspectives, while others more slowly. A summary of the slope industry over the past five years, seen from various perspectives, gives an insight into how the sector has changed.

ACHIEVEMENTS
THE SLOPE MANAGEMENT INDUSTRY NOW… AT A GLANCE

The slope scenario now is different than what it was back in 2009. Since then, the awareness of disasters in general, not just landslides, has grown and many government agencies and communities alike have learnt to prepare and brace for the onslaught of rain and landslides during monsoon seasons, otherwise known as 'disaster' season. The effects of climate change have also reinforced the public's awareness of extreme rain events and its triggering effect on slope failures.

In this climate of awareness, changes in legislation to provide more enforcement power to local and district authorities have taken place. Hazard and risk mapping for key at-risk areas throughout the country is fully underway, with hazard mapping of all risky slopes along federal roads being completed. Components of early warning systems are in various stages of completion and are awaiting integration to form complete systems. Loss assessment proformas and procedures need to be part of forensic data gathering processes at all levels of government, while information systems to ferry information and data between various components has been specified. The need for a formal training facility for geotechnical engineering has been addressed through the set-up of a new JKR training centre, and public awareness and education continues to play a significant role in keeping slope safety in the minds of the public. One of the major improvements in loss reduction measures is the proliferation of new slope development guidelines, while emergency response will be improved with the drafting of the Standard Operating Procedures for landslide emergencies. Research and development in slope engineering and management has been progressing on separate but parallel tracks, and it is hoped that a closer collaboration between researchers and JKR will usher future innovations and creativity in developing new methodologies and finding solutions and methodologies for safer slopes in Malaysia.

POLICY & INSTITUTIONAL FRAMEWORK

The past five years has seen significant improvements in policy and institutional framework. There is now more regular and ongoing communication of slope management activities among relevant government agencies, enabling JKR to approach slope issues from a broader perspective. There is now a proliferation of guidelines and establishment of institutional set-up for slope development approval within various levels of government. Efforts have been made to improve existing legislation to tighten controls over slope development and management in the country.

More inter-agency coordination

The Inter-governmental Committee on Slope Management (ICSM) was set up in 2011 to allow various government agencies and stakeholders to meet and discuss slope matters. The ICSM meets twice a year. The ICSM addresses issues concerning better coordination in slope management and landslide disasters including safety and preventive measures, public awareness, planning development, standards, policies and guidelines.

Mainstreaming landslide risk planning and risk reduction

Efforts have been made to integrate landslide risk assessment and risk reduction planning into development policies of other sectors. A number of agencies work with CKC for the purpose of assessing landslide risk and planning risk reduction. As a result, many local authorities include landslide risk reduction measures in their planning and slope development policies that are implemented through their one stop centres. Since the release of the NSMP, several state governments have drafted slope development guidelines to be applied to all new developments within their respective states.

Changes in legislation

The Street, Drainage and Building Act 1974 (Act 133) is being revised to include provisions on slope management. The amendments to this Act have been approved by the Ministry of Wellbeing, Housing and Local Government and are awaiting approval from the Cabinet.

Striving for professionalism

With regards to the proposal to set up a dedicated Slope Engineering Agency, the recommendation has not been put into action due to current economic and other factors that do not permit the establishment of a new agency for slope management. Nevertheless, this action plan is still being strongly held by CKC for implementation when the necessary resources and approvals are obtained.

The action plan regarding disaster management is a matter dealt with by the ICSM in liaison with the National Disaster Management Agency (NADMA), a new agency established under the purview of the National Security Council or *Majlis Keselamatan Negara* (MKN).

In terms of collaboration with international agencies, CKC has been designated as a Centre of Excellence by the International Consortium for Landslides (ICL), which is based in Kyoto, Japan. ICL is a non-governmental and non-profit scientific organisation with a mission to reduce landslide risk. In addition, CKC is a member of the South-East Asian Network for Landslide Risk Management.

The establishment of the NSMP has contributed to numerous positive initiatives and plans being undertaken by CKC and other government authorities and agencies.

Risk Management

CKC conducted a study *"Kajian Menentukan Kriteria 'Acceptable Risk' dan 'Tolerable Risk' dan Aplikasi dalam Penilaian Risiko Tanah Runtuh"* from 2014 to 2015 to assess the level of acceptable risk of fatal landslides in some urban and rural areas within the Klang Valley. The expected outcome of this study was to derive a societal risk threshold that would provide slope approving authorities, planners and engineers with a tool to determine whether a hillside development should or should not be approved. The outcome of the study was a society-defined parameter, in addition to the existing technical parameters stipulated by the state's guidelines and requirements.

RESULTS

Since the NSMP was released, there has been more control over slope development in several states, where stringent guidelines have been compiled into state hillside development guidelines.

MAJOR ACHIEVEMENT

Empowerment of Local Authorities in the Street, Drainage and Building Act (Act 133)

In 2014, the Ministry of Wellbeing, Housing, and Local Government started a revision of the Street, Drainage and Building Act 1974 (Act 133) which stipulates proper procedures of erecting, constructing and maintaining buildings and the infrastructure around them. Its scope is fairly comprehensive in the control and monitoring of municipal-owned assets and empowers local authorities to take regulatory and legal measures against any infractions. However, the act did not recognise and address slopes as assets and as such, had no provisions for control over the planning, building and maintenance of slopes. Jabatan Kerajaan Tempatan has revised the act to include slopes, thus giving local authorities the much needed enforcement power to ensure compliance on regulations for slope developments and take legal action as and when needed. It is currently in the process of being vetted by the Ministry, and once approved, tabled to the Cabinet for ratification.

CHALLENGES AHEAD

Need More Awareness of the Master Plan

Some state agencies are not familiar or even aware of the existence of the NSMP. Among the agencies that are, they are still uncertain about their responsibilities on slopes and disaster management. Difficulties in determining execution of tasks seem to be faced by state authorities when there is uncertainty in identifying slopes under the purview of the federal and state government.

Limitations of Institutional Powers

Although CKC is the caretaker of the NSMP, it is not a full-fledged legal institution with legislative authority on slope matters. The SEA as described in the 2009 NSMP has not been set up. The powers and authority of CKC and JKR are limited to federal roads and slopes along these federal roads. Although CKC is consulted on slopes within areas that fall under the jurisdiction of the states, its determining powers for purposes of enforcement is limited. The deciding voice is still with the states.

State jurisdictional issues also seem to hinder the implementation of the NSMP at a higher scale. CKC and the Federal Government lack the authority and power when it comes to matters that fall under the control of the States, especially land and water.

HAZARD MAPPING & **ASSESSMENT**

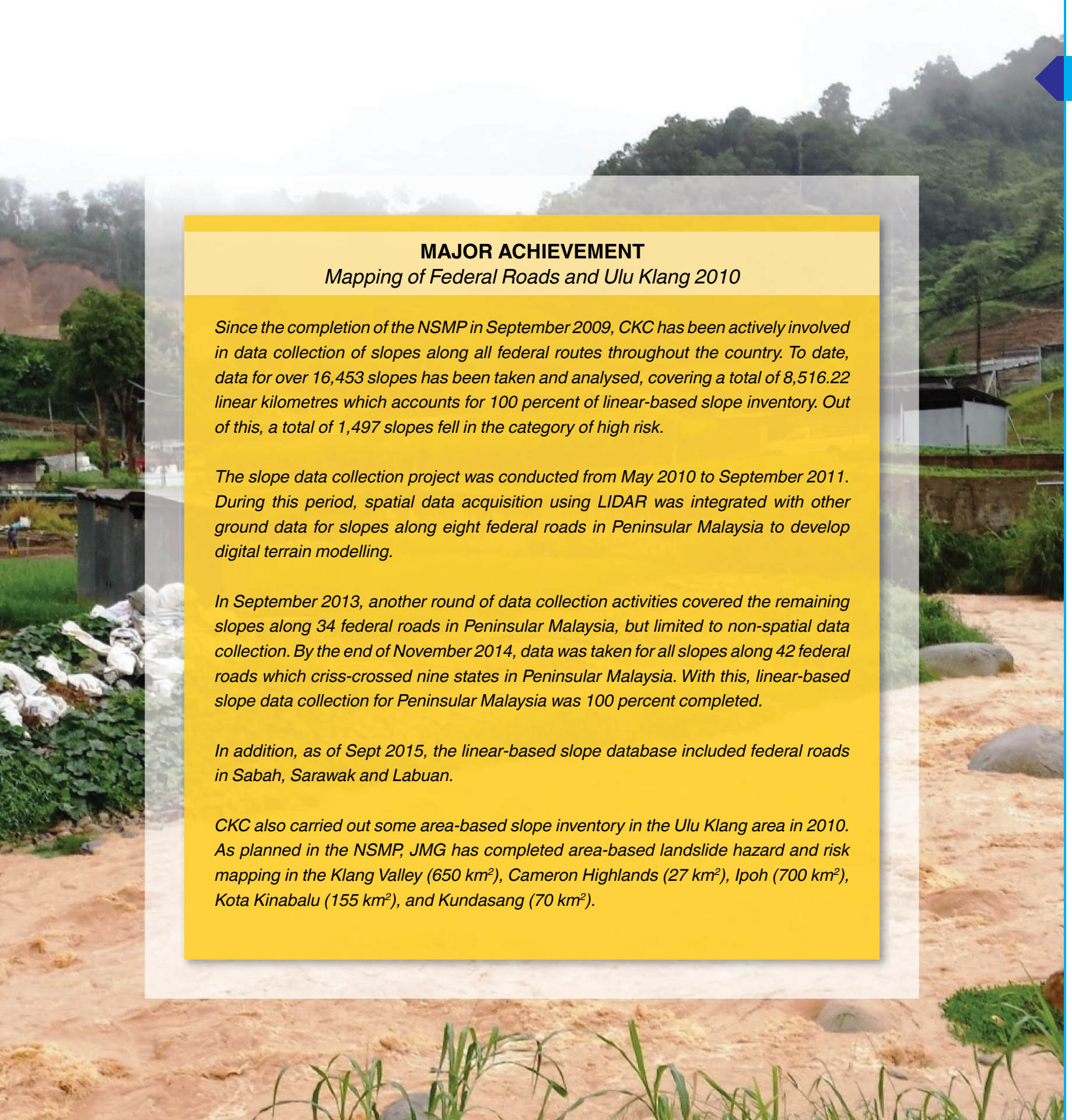
From 2010 to 2011, JKR engaged in a series of slope risk mapping activities using Light Detection and Ranging (LIDAR). The result of that activity is the production of hazard and risk mapping of slopes along all federal routes throughout the country. Also from 2014 to 2016, the Department of Mineral and Geoscience or *Jabatan Mineral dan Geosains* (JMG) carried out area-based landslide hazard and risk mapping of 1,350 km^2 within municipality areas as planned in the 2009 NSMP.

RESULTS

Since the launch of the NSMP, CKC has completed the slope inventory activities along all Malaysian federal routes as part of the hazard mapping and assessment projects as recommended.

JMG initiated the area-based mapping and hazard analysis by implementing the *Projek Penghasilan Peta Bahaya & Risiko Cerun* (PBRC). The project was carried out in the Klang Valley, Cameron Highlands and Ipoh, covering 1,350km^2. It was also carried out in Kundasang and Kota Kinabalu. PBRC covers only some of the landslide-prone areas recorded throughout the country.

The Malaysian Remote Sensing Agency (MRSA) completed a regional susceptibility map for Selangor and Penang. The rest of the landslide-prone areas have yet to be covered.



MAJOR ACHIEVEMENT

Mapping of Federal Roads and Ulu Klang 2010

Since the completion of the NSMP in September 2009, CKC has been actively involved in data collection of slopes along all federal routes throughout the country. To date, data for over 16,453 slopes has been taken and analysed, covering a total of 8,516.22 linear kilometres which accounts for 100 percent of linear-based slope inventory. Out of this, a total of 1,497 slopes fell in the category of high risk.

The slope data collection project was conducted from May 2010 to September 2011. During this period, spatial data acquisition using LIDAR was integrated with other ground data for slopes along eight federal roads in Peninsular Malaysia to develop digital terrain modelling.

In September 2013, another round of data collection activities covered the remaining slopes along 34 federal roads in Peninsular Malaysia, but limited to non-spatial data collection. By the end of November 2014, data was taken for all slopes along 42 federal roads which criss-crossed nine states in Peninsular Malaysia. With this, linear-based slope data collection for Peninsular Malaysia was 100 percent completed.

In addition, as of Sept 2015, the linear-based slope database included federal roads in Sabah, Sarawak and Labuan.

CKC also carried out some area-based slope inventory in the Ulu Klang area in 2010. As planned in the NSMP, JMG has completed area-based landslide hazard and risk mapping in the Klang Valley (650 km^2), Cameron Highlands (27 km^2), Ipoh (700 km^2), Kota Kinabalu (155 km^2), and Kundasang (70 km^2).

Slope Hazard And Risk Mapping Project Areas

No.	Slope Hazard and Risk Mapping Project Area	Area (km²)
1	Gombak-Selayang-Rawang-Batang Kali, and Cheras Selatan-Kajang-Bangi, Selangor	650
2	Cameron Highlands, Pahang	275
3	Ipoh, Perak	200
4	Kota Kinabalu, Sabah	155
5	Kundasang, Sabah	70
	TOTAL	**1,350**

CHALLENGES AHEAD

Lack of Landslide Expertise

The main challenge in landslide hazard assessment is the availability of landslide specialists to carry out the works. Understanding of landslide mechanisms and the characteristics of soil and rocks in tropical areas are crucial in landslide hazard formulation. CKC's constraints in manpower resources would delay the uploading of field records into their system and production of analysis required in order to rate each of the slope.

Monetary allocation for the landslide hazard assessment is limited. The main priority is given to the development of infrastructure, and the landslide budget is only limited to slope repair works and occasionally for slope upgrading works.

Lack of Historical Landslide Triggering Records

To transition from susceptibility map to hazard maps, geospatial engineers need temporal historical rainfall and other records. This is to get a better view of hotspots and hazard zonation areas.

EARLY WARNING AND **REAL-TIME MONITORING SYSTEMS**

Since the launch of the NSMP, CKC has embarked on several early warning and real-time monitoring system (EWS) projects as recommended.

Innovation/Techniques and Methodologies

CKC, in setting up its rainfall gauges, has tied the data to rainfall-landslide correlation models. The models need to be calibrated during heavy rainfall periods. CKC is also researching on intensity versus duration rainfall models and the intensity versus warranted rainfall models. MetMalaysia (*Jabatan Meteorologi Malaysia*) is constantly upgrading to improve its delivery of forecasted rainfall. The Department of Irrigation (*Jabatan Pengairan dan Saliran* or JPS) has developed its Debris and Mud Flow Warning System, which is currently under testing.

Innovation/Prediction Models

The models developed by CKC and JPS are being tested for their accuracy. These models have been calibrated with associated rainfall during landslide events. As with all good forecasting models, time improves its accuracy. In the plans, the models shall be tied to the Quantitative Precipitation Forecast (QPF) and Numerical Weather Predictor (NWP) to provide a longer lead time for forecasting.

Prediction Capability

JPS with its soon-to-be-completed system in *Pengurusan Ramalan dan Amaran Banjir* (PRAB) and the Forecast Data Centre (FDC) can provide detailed analysis for nowcasting and forecasting of rainfall within a 4-km range. But currently its network of automated rainfall gauges are located primarily for flood events purposes, not for slopes. CKC are also in talks with MetMalaysia for rainfall forecast to extend the lead time to five days in the early warning system. An initial use of MetMalaysia's forecasted rainfall indicated its usefulness. MetMalaysia has enough real-time data for an extensive coverage for nowcasting of rainfall throughout the country.

Once the models are proven and better defined, the early warning system will be online and connected with NADMA.

The relevant stakeholders are working independently, but with common objectives that can lead to eventual real-time collaborations.

JPS, in improving its debris and mudflow models, rely on CKC for its landslide event inventory. MetMalaysia is a provider of QPF and NWP, which is required for nowcasting and forecasting respectively for both CKC and JPS.

The stakeholders are working together for a common interest, which is a strong indicator that their progress individually and collectively are on the right track to fulfil the aspiration for a national landslide early warning system.

RESULTS

The realisation of a national level landslide early warning system is on the right track. There are many forecasting systems that are being tested currently. The output quality is being rigidly tested and is being deployed. However, the scenario for real-time disasters has yet to be tested to its fullest.

With all the activities in the early warning systems for landslides, stakeholders have successfully developed discrete systems and are being tested at site.

CHALLENGES AHEAD

With all of the priority areas being covered by the Doppler radars, MetMalaysia can now produce a five-day rainfall forecast. With this, CKC would have the capacity to forecast landslides two days in advance with its current models.

LOSS ASSESSMENT

The implementation progress for the loss assessment component is still at an early stage. To date, no loss assessment data compilation, integration and dissemination procedures for landslides have been established by government agencies outside of CKC. There are loss assessment reports produced by JKR after landslide events, but the figures are confined to direct losses on public infrastructure and assets.

Similarly, no dedicated financial assessment on the recovery of rescue and relief costs is currently being conducted by the various stakeholders, but some loss data are obtainable as part of general case reports.

In terms of research, studies carried out in landslide loss assessment is minimal, and any research done so far is not a direct result of the initiatives recommended by the NSMP.

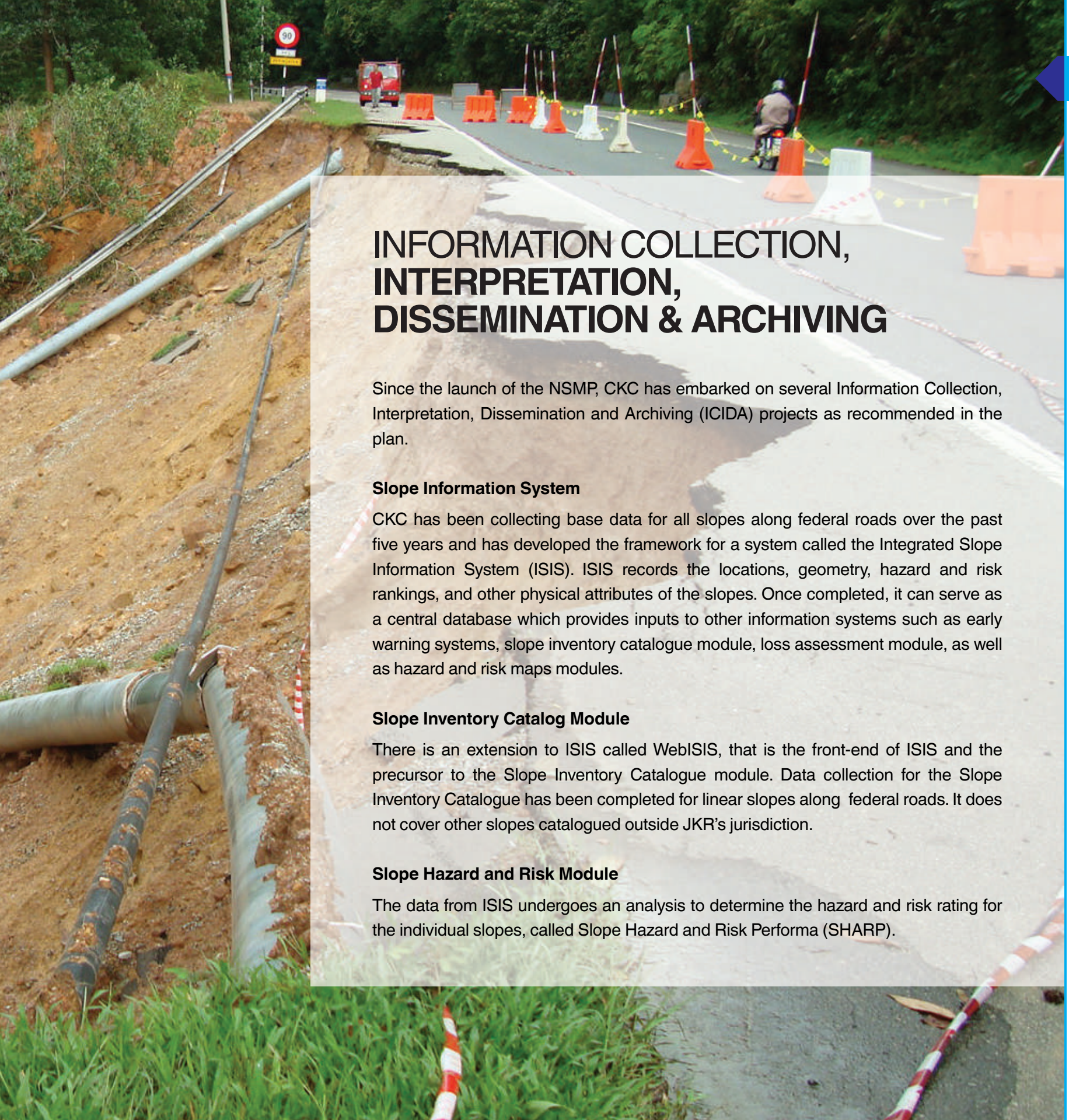
To its credit, CKC has initiated some preliminary planning in terms of general direction, and broad implementation ideas have been identified. Some ongoing effort in loss assessment data collection is currently being undertaken as part of the existing reporting system for slope repair involving CKC. However, data on economic loss due to landslides is generally limited to the fund administered by CKC and voluntary data provided by external parties such as local authorities.

RESULTS

The implementation progress for the loss assessment component is still at an early stage. Concrete progress in the form of the development of economic loss assessment guideline, an integrated system for data gathering, analysis and integration, and joint economic loss research programs with research organisations have yet to materialise.

CHALLENGES AHEAD

Loss assessment implementation has been constrained by a lack of a dedicated team and financial resources to work on the strategy and action plan implementation. Day-to-day work priorities tended to keep the activity of loss assessment on the back burner, and there has been difficulty in coming up with a framework to encourage or compel external parties to gather and transmit data on loss assessment to CKC.



INFORMATION COLLECTION, **INTERPRETATION, DISSEMINATION & ARCHIVING**

Since the launch of the NSMP, CKC has embarked on several Information Collection, Interpretation, Dissemination and Archiving (ICIDA) projects as recommended in the plan.

Slope Information System

CKC has been collecting base data for all slopes along federal roads over the past five years and has developed the framework for a system called the Integrated Slope Information System (ISIS). ISIS records the locations, geometry, hazard and risk rankings, and other physical attributes of the slopes. Once completed, it can serve as a central database which provides inputs to other information systems such as early warning systems, slope inventory catalogue module, loss assessment module, as well as hazard and risk maps modules.

Slope Inventory Catalog Module

There is an extension to ISIS called WebISIS, that is the front-end of ISIS and the precursor to the Slope Inventory Catalogue module. Data collection for the Slope Inventory Catalogue has been completed for linear slopes along federal roads. It does not cover other slopes catalogued outside JKR's jurisdiction.

Slope Hazard and Risk Module

The data from ISIS undergoes an analysis to determine the hazard and risk rating for the individual slopes, called Slope Hazard and Risk Performa (SHARP).

Early Warning System

Some development for an early warning system has been initiated, although it is not based on any data from ISIS.

Loss Assessment Module

No development on a loss assessment module has been initiated.

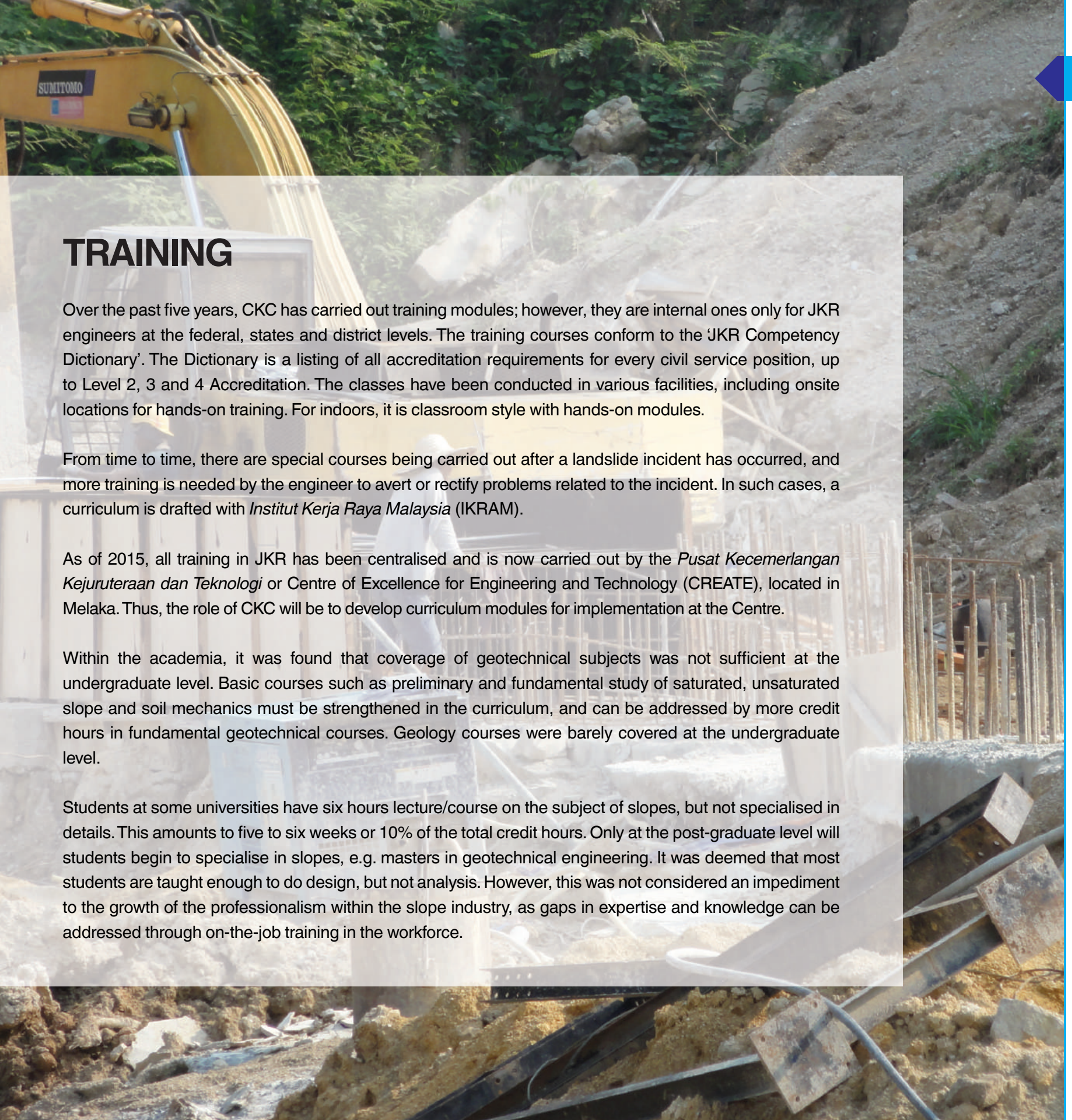
RESULTS

The realisation for an ICIDA component is on the right track. There are many systems that are being tested currently. The output quality is being rigidly tested and is being deployed. However, the scenario for real-time disasters have yet to be tested to its fullest.

With all the activities, CKC has successfully developed discrete systems. The next step for them is to integrate these systems into a single unit with capabilities to share the information.

CHALLENGES AHEAD

Once all the systems are in place, they can be integrated. With integration, data can easily be shared with other agencies. When data is shared, efficiency should increase.



TRAINING

Over the past five years, CKC has carried out training modules; however, they are internal ones only for JKR engineers at the federal, states and district levels. The training courses conform to the 'JKR Competency Dictionary'. The Dictionary is a listing of all accreditation requirements for every civil service position, up to Level 2, 3 and 4 Accreditation. The classes have been conducted in various facilities, including onsite locations for hands-on training. For indoors, it is classroom style with hands-on modules.

From time to time, there are special courses being carried out after a landslide incident has occurred, and more training is needed by the engineer to avert or rectify problems related to the incident. In such cases, a curriculum is drafted with *Institut Kerja Raya Malaysia* (IKRAM).

As of 2015, all training in JKR has been centralised and is now carried out by the *Pusat Kecemerlangan Kejuruteraan dan Teknologi* or Centre of Excellence for Engineering and Technology (CREATE), located in Melaka. Thus, the role of CKC will be to develop curriculum modules for implementation at the Centre.

Within the academia, it was found that coverage of geotechnical subjects was not sufficient at the undergraduate level. Basic courses such as preliminary and fundamental study of saturated, unsaturated slope and soil mechanics must be strengthened in the curriculum, and can be addressed by more credit hours in fundamental geotechnical courses. Geology courses were barely covered at the undergraduate level.

Students at some universities have six hours lecture/course on the subject of slopes, but not specialised in details. This amounts to five to six weeks or 10% of the total credit hours. Only at the post-graduate level will students begin to specialise in slopes, e.g. masters in geotechnical engineering. It was deemed that most students are taught enough to do design, but not analysis. However, this was not considered an impediment to the growth of the professionalism within the slope industry, as gaps in expertise and knowledge can be addressed through on-the-job training in the workforce.

Professional bodies such as the Institute of Engineers Malaysia also provide courses in geotechnical engineering through seminars and workshops, although the content is determined by the individual trainer and not following a national agenda or training curriculum on geotechnical engineering.

RESULTS

Further discussion among the universities is needed to determine whether the current engineering curriculum needs to be upgraded to produce university graduates with more knowledge of geotechnical engineering. For the practitioners, the establishment of a JKR training centre could fulfil the needs for more professional training on geotechnical subjects. Although the country has a pool of civil engineers, the number of geotechnical engineers is much smaller. Currently, we have 16 professionals to serve as accredited or independent checkers for all the major slope developments throughout the country, which is relatively a small number. In addition, a standardised training template is needed to ensure uniformity of slope practices and raise the bar of professionalism and expertise among engineers, contractors, and maintenance personnel throughout the country.

CHALLENGES AHEAD

As discussed above, the university curriculum needs to be reviewed to include more geotechnical engineering courses for specialisation into this field. This applies in particular to post-graduate studies and possibly as electives for undergraduate studies. As for JKR personnel and practitioners in the slope industry, the establishment of a training program consisting of geotechnical engineering course modules based on a standardised framework should encourage the entry of more civil engineers into the geotechnical discipline. This would increase the pool of working professional geotechnical engineers as well as increase the level of professionalism.

PUBLIC AWARENESS **AND EDUCATION**

Among the components listed in the NSMP, Public Awareness and Education (PAE) is one that is most actively implemented. The public awareness and education function within CKC began with a two-year program that ran from 2008 to 2010 called "*Kajian Public Awareness and Education Programs*". Awareness and educational material were created for various target groups, comprising state and municipal policy, planning, and engineering departments; private sector companies; residents in at-risk areas; general public; schoolchildren; and the media.

The public awareness and education infrastructure allowed CKC to continue this function in the years after 2010 until now. From 2011 to the present, CKC has been conducting five to six community outreach programs every year, as well as carrying out above-the-line promotion of key messages through print and broadcast media. These comprised printed advertorials and televised public service announcements (PSAs).

The only difficulty encountered in implementing this program is the measurement of performance, which relies on a social survey to track changes in the knowledge, attitude, perception and behaviour of the community groups. This is a lot easier said than done, as the survey has to be implemented in five different cities and more importantly, administered to the same respondents to compare with the baseline survey taken in 2008. As population goes, people come and go, which makes it very difficult to get the very same people to fill out the surveys over a period of years.

RESULTS

The level of awareness of landslide risk and slope safety has increased over the past five years, depending on the location and socioeconomic profile of the affected population. For example, Majlis Perbandaran Ampang Jaya affirms that there is a high level of awareness among residents in Ulu Klang, with residents taking proactive steps towards reporting and mitigation. Likewise, local authorities and district offices in other high-risk areas echo the same observation. This is due to the public awareness campaigns and exposure carried out by CKC as well as other authorities and agencies. Even the nature of coverage of slope issues in the print media such as newspapers has changed from reporting on landslides and events that have happened to reporting on signs of failures, bad maintenance practices or lack of mitigation measures before landslides occur.

CHALLENGES AHEAD

However, the awareness is unevenly spread throughout the country and more needs to be done to spread the awareness not only among urban residents, but also within rural and remote areas with communities who may be vulnerable due to encroaching development. There needs to be a concerted effort not only by CKC but other authorities and agencies to disseminate more knowledge on monitoring, mitigation and reporting actions to be taken by the population in at-risk areas.

LOSS REDUCTION **MEASURES**

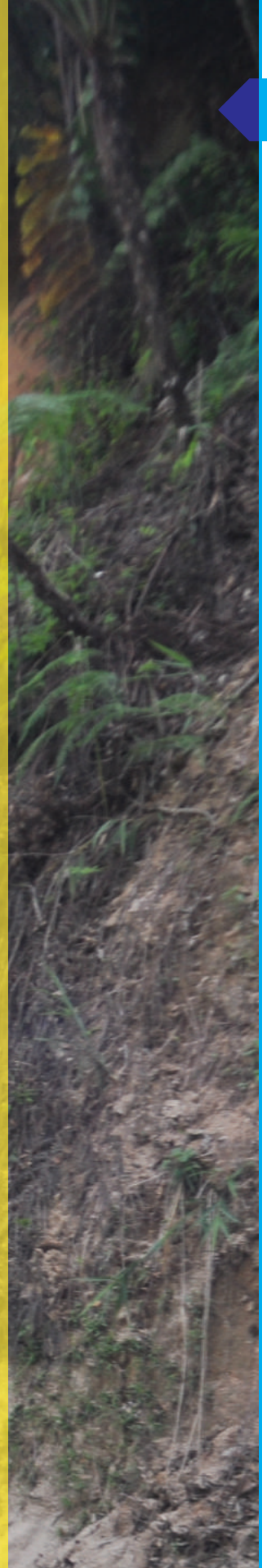
The implementation of strategies delineated in the 2009 NSMP has been carried out with mixed results.

Standardise, Implement and Review Guidelines

Many guidelines have been developed and updated by various agencies after the rollout of the NSMP. Soon after the creation of CKC in early 2004, the first guideline on routine maintenance and risk assessment was produced in 2005. This was later revised in 2006 by adopting the maintenance guideline produced by the Geotechnical Engineering Office, Hong Kong (GEO).

After the approval of the NSMP in 2009, at least eight guidelines relating to planning and design were issued by various agencies, namely the *Garis Panduan Pembangunan Di Kawasan Bukit* by the Ministry of Housing and Local Government (KPKT) in 1997; *Garis Panduan Pembangunan Di Kawasan Tanah Tinggi* by the Ministry of Natural Resources and Environment (NRE) in 2005; and *Garis Panduan Pembangunan Di Kawasan Bukit, Tanah Tinggi* by KPKT in 2009.

At the state level, there are three different guidelines: *Garis Panduan Perancangan Pembangunan Di Kawasan Bukit Dan Tanah Tinggi Negeri Selangor, 2010; Garis Panduan Perancangan Pembangunan Di Kawasan Bukit Dan Cerun Bagi Wilayah Persekutuan, Kuala Lumpur, 2010*; and Safety Guideline for Hillsite Development, 2012 (Pulau Pinang).



Experienced Checkers to be Involved in the Development Process

For a loss reduction strategy to be effective, early involvement in the overall process is crucial. This strategy calls for a panel of experienced checkers to be involved in the slope development process, starting as early as the application for land conversion to the Land and Mineral Office. Initially, CKC served to vet through geotechnical reports for slope development approval upon request by the local authorities, but due to manpower constraints, had to relinquish this task to the district and state JKR. However, CKC will assist with projects that involve Environmental Impact Assessments (EIAs) while geotechnical reports for Selangor and Kuala Lumpur are reviewed by Kumpulan Ikram Sdn. Bhd. (KISB).

Planning and Implementation of Relevant Acts and Creation of Checklists for Planning, Design, Construction and Maintenance

The NSMP highlighted the relevant acts that need to be planned and implemented, but as the SEA did not materialise to carry them through, the impetus to push for slope-related legislation also did not materialise. However, the Department of Housing, recognising that one of the key factors of success to better slope control and management was to empower the front-line agencies that deal with developers, contractors and slope owners such as the local authorities and district offices, started the revision of the Street, Drainage and Building Act 1974. Essentially, the revision would give the authorities enforcement power to curb infractions of non-compliance on slopes. This review has been completed and is being ratified by the Ministry of Housing for tabling to the Cabinet. Although it is a revision, it is a significant step forward towards greater control over slope management at the local government level.

To date, there has been substantial progress in pushing for slope legislation and drawing up checklists. The planning, design and construction checklists need to be further revised and made public, and checklists for maintenance need to be prepared.

Establishment of Regulations and Database for Incentive and Disincentive Schemes

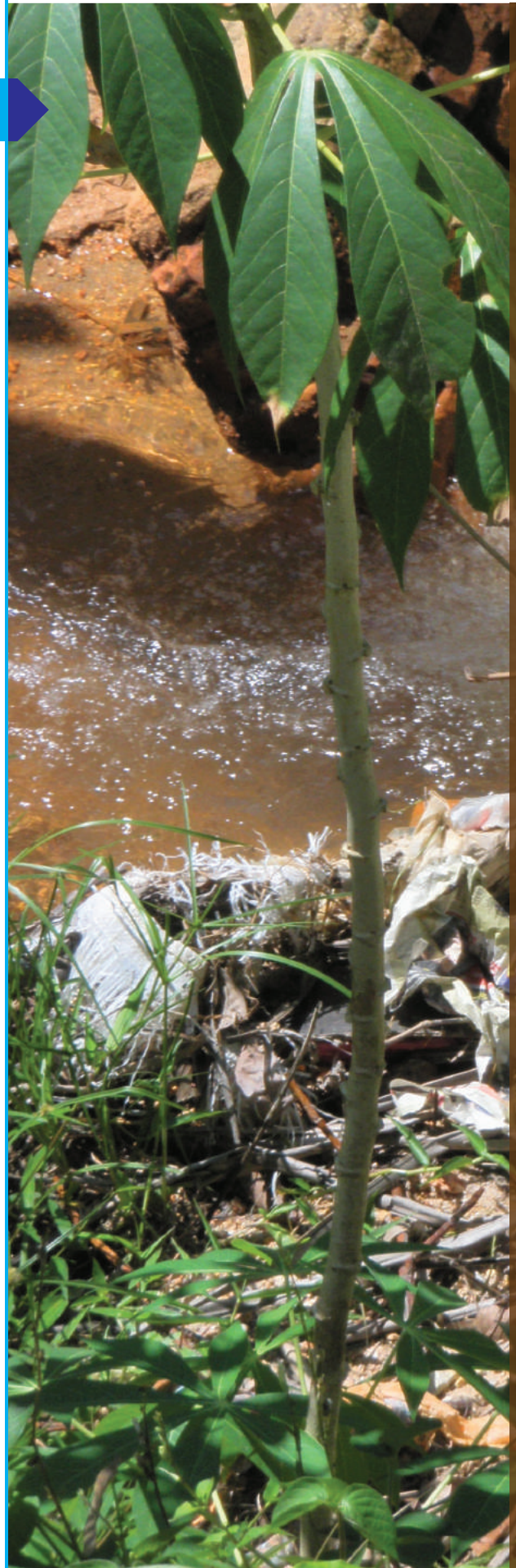
Even though this strategy was not implemented, the incentive and disincentive schemes for practitioners and developers are preferred by CKC for quality control and assurance purposes. Discussions with the Ministry of Works indicate that incentives are preferred over disincentives, although further discussion is needed to formulate the incentives.

RESULTS

Overall, the progress of Loss Reduction Measures is mixed, with some strategies showing significant progress while others not so.

CHALLENGES AHEAD

While eight new guidelines have been drafted over the past five years, there have been comments from the industry that the presence of so many guidelines with varying parameters and requirement is confusing. The revision of Act 133, the Street, Drainage and Building Act, paves the way for increased control over errant slope practices. However, other strategies such as the proliferation of independent checkers and the creation of incentives to encourage good practices need to be further refined and encouraged. An important activity to carry out is to engage and coordinate stakeholders for strategy implementation. And finally, retrofitting works based on prioritisation from hazard and risk maps needs to be carried out. Should retrofitting not be feasible due to financial or other reasons, a strong culture of systematic, routine maintenance inspection is necessary.



EMERGENCY PREPAREDNESS, **RESPONSE & RECOVERY**

The main platform or point of coordination and discussion on pre-disaster matters and disaster preparedness between JKR, disaster management agencies and first responders is the ICSM. During disasters, coordination is determined by the National Security Council, Directive 20 (*Majlis Keselamatan Negara Arahan 20*).

Define and put in place clear policies, mechanisms and procedures

In emergencies, JKR Road is the branch in charge of procedures during landslides. As for the Standard Operating Procedures (SOPs) for landslides, CKC has drafted and submitted the landslide procedures to NADMA earlier this year.

Provide suitable equipment and locate them at landslide prone areas

The provision of equipment and other accoutrement falls under the responsibility of the district JKR offices. Every district has a panel of reliable contractors and machinery that they can call upon during emergencies. CKC and other federal branches can add to the list if there is a need for a disaster-specific piece of equipment. These facilities should be available to landslide disasters on private land as well.

Set up an emergency control centre with communication networks

Coordination and management of disasters are spearheaded by the JKR Maintenance branch. This applies to all types of disasters including floods as well as landslides. Most of the activities under JKR during disasters involve road closures, alternative routes, and monitoring of road conditions for motorists and emergency responders.

For landslide disasters along roads, the control centre is located in the JKR headquarters. Again, its function is for coordinating road closures, identifying alternative roads, and advising agencies and general public on which roads to take.

Conduct Inter-Agency Drills Among Various Emergency Response Agencies

NADMA conducts drills, but has yet to commence one specifically for landslides. Recently, the Ministry of Works has set up a committee for conducting drills on JKR activities related to landslide incidents (road closures and road diversions. This is within KKR and JKR departments only, and does not involve NADMA or emergency response agencies. It is a large-scale drill involving federal, state, and district JKR personnel for lab simulation. The objective of the drill is to test out its SOP as well as establish a clear and efficient line of communication which reports quickly from the ground level right up to the Minister of Works, who needs round-the-clock, up-to-date information during disasters.

Provide Adequate and Immediate Support to Emergency Stakeholders in the Aftermath of Landslides

CKC's supporting role to emergency stakeholders is provide technical advice as well as disseminate key forensic information among relevant parties. Advice includes safety and stability of the landslide site, whether emergency first responders can safety enter the red zone, short-term measures (such as how to slow down slope movement and what are the temporary measures), as well as prescribing long-term measures for recovery.

Provide Advisory and Forensic Services and Help to Bring the Affected Infrastructures to Near Operating Conditions

As mentioned, during disasters CKC sees its role as providing advice on the safety of slope conditions. CKC will also accompany the emergency responders to the site.

RESULTS

CKC is meeting the KPIs set by JKR to arrive at the emergency site within one hour. In terms of readiness, CKC has the groundwork set for landslide emergencies. Now that it has drafted the SOP for landslide emergencies and submitted it to NADMA, it will have to be ground-tested through drills with other first responder agencies.

CHALLENGES AHEAD

With the SOP for landslide emergencies in place, practical drills among first responders as well as residents need to be carried out. Risk communication and preparedness are key elements of disaster resilience.

RESEARCH & **DEVELOPMENT**

Considerable research on slope engineering is being carried out by Malaysian universities and institutions of higher learning. A review of research topics conducted by researchers show that studies range from basic and fundamental topics such as soil investigation, slope design, and ground water movement to prediction for rainfall, early warning systems, debris and mudflow modelling to mapping such as susceptibility and hazard maps. The funding source for such research is varied, and comes from government sources such as the Ministry of Higher Education (MOHE) and the Ministry of Science, Technology and Innovation (MOSTI) to private institutions to international funding agencies, e.g. Japan International Cooperation Agency (JICA). Thus, the direction of research to be carried out is determined jointly by the funding agencies and the universities.

Research on slope engineering falls into two broad categories, fundamental and applied. Fundamental research serves to provide greater understanding of slope engineering within the realm of academia while applied research promotes innovation, productivity and process efficiencies. Applied research such as the testing and determination of optimal vegetation to promote slope stability and risk assessment has been taken up by JKR for practical and widespread applications.

In striving to provide more impact to the industry through research, universities have suggested that JKR provide funding agencies with a short–, medium– and long-term research agenda which researchers can refer to when proposing studies. This is due to the fact that during the review of ongoing studies among the academia, it was found that there was an oversupply and redundancies in certain research areas (i.e. hazard mapping), which overlapped with government mapping initiatives. Research topics were also not aligned with JKR goals and needs, making it difficult for wider adoption of research results within JKR. At this point in time, funding agencies are not aware of JKR's current research interest, needs, issues and direction. There is no centralised research network in slope management and engineering, while good communication and collaboration between scientists and practitioners is still elusive.

Adoption and sharing of results and data among agencies also calls for the need for uniformity and standardisation of procedures. This was one of the issues raised during the stakeholder meetings with the research community. Currently, there are different formats, protocols and projection resolutions being applied, which prevent data from being easily shared among agencies. This will have to be addressed among practitioners and researchers for a standardised approach.

Sustainability in slope practices was unanimously agreed by researchers to be a priority, but no concerted effort towards research in this area has been made except for a project in the potential use of compost as a chemical slope strengthening agent.

Overall, the response by the academia for JKR in having a more active role in spearheading research initiatives has been positive, with calls for more research seminars and dialogues to be hosted by JKR and a consolidated budget in slope-related research to be managed by JKR with the support of government agencies, research institutes, professional bodies, and non-government organisations.

RESULTS

Although universities and other research organisations are involved in numerous research projects, uptake by JKR is low, owing to the fact that research goals or objectives are not aligned to JKR needs and goals. A research agenda that is shared by JKR with fund managers, research institutions and universities would be instrumental in more focused research and innovation to emerge in the years ahead.

CHALLENGES AHEAD

There is a strong need for the sharing of CKC research direction and goals with research institutions and funding agencies to create a research community which fosters innovation and creativity in coming up with novel approaches and solutions in slope management. An integrated approach to disaster approach needs to be further promoted, with emphasis on excellent science that encourages industrial leadership and addresses societal challenges. Local research should aim at producing world-class science, removing barriers to innovation, and making it easier for the public and private sectors to work together in delivering innovation.

ASPIRATIONS AND WISHLISTS

- ASPIRATIONS AND WISHLISTS
- CAWANGAN KEJURUTERAAN CERUN
- STAKEHOLDERS IN THE SLOPE SECTOR
- EXPERT PANEL ON SLOPE MANAGEMENT
- WISHLIST FROM COMMUNITIES

ASPIRATIONS AND WISHLISTS

The Review of the NSMP 2016 included inputs and feedback from various stakeholders on what were their aspirations and wishlists for more robust slope management in the country. In this way, the Master Plan is not just an objective analysis of the requirements for slope management, but as a "living document", it is a reflection on what people on the ground as well as managers and policymakers think should be incorporated into a plan for safer slopes. Their concerns, wishlists and aspirations were considered and included in the crafting of the strategy revisions put forth in this plan.

CAWANGAN KEJURUTERAAN CERUN, JKR

During the course of discussions and question-and-answer sessions with the CKC sections regarding the status and progress of the NSMP implementation, they were also asked questions on what they thought of the NSMP and what they envisioned CKC to become. This is because some of the impediments in fulfilling the action plans and KPIs were due to the fact that the SEA—the physical endgame of the NSMP—did not materialise. A number of the action plans, particularly for Policy and Institutional Framework, hinged on the fact that compliance and adherence by other government agencies would come through the statutory powers of an independent agency.

ON AN INDEPENDENT SLOPE AGENCY

CKC sections stated that a specialised technical agency for slope management and landslide mitigation was still needed, but given the economic and financial climate of the country, the establishment of such an agency would not be a wise decision at this time. However, the idea of an agency staffed with experienced and dedicated engineers and specialists to prevent landslide disasters and engage in disaster risk reduction was germane to the establishment of a strong and successful slope safety system within the country by the year 2023.

The set-up would be similar to the Geological Institute of Indonesia, which is an independent agency for earthquakes, the number one disaster for Indonesia. Unlike a government department, where turnaround is high and staffers are constrained by departmental pressures, the staffing of the Institute comprises specialist engineers and researchers whose skillsets are specialised in the field of their domain.

Until such time when the establishment of SEA becomes viable, CKC in the interim has an instrument for coordinating slope management throughout the country called the Inter-Governmental Committee on Slopes (ICSM), which is a forum and platform for all government agencies at the federal, state, and municipal level to converge on slope policies, standards, procedures and guidelines. The year 2016 marks its 7th year of implementation, and it has been moderately successful for CKC in terms of data sharing, dissemination of its latest proformas and guidelines, and setting up coordination committees of mutual benefit.

ON THE IMPORTANCE OF SETTING UP A DEDICATED SLOPE UNIT FOR PROFESSIONAL COMMITMENT AND TECHNICAL EXPERTISE

Experienced and seasoned officers within CKC strongly promote the idea of a dedicated technical agency where specialised knowledge and know-how on slope engineering and management is accumulated and stored. Because landslides are a matter concerning people's lives and property and has significant impact on the local economy, the agency must be staffed with officers who are experienced and knowledgeable on subjects ranging from the technical (such as landslide triggering factors, landslide mechanisms, soil mechanics) to emergency preparedness and response (knowing which spots any survivors of a landslide are likely to be found on a landslide site and searching them within the window of survival time) to mass communication (how to disseminate critical, life-saving information to target communities ranging from urbanites to indigenous people).

To accumulate such knowledge, a posting at CKC requires five years. However, many officers get transferred out within three years and new staffers come in with no prior experience in slopes. But due to the heavy responsibility of landslide hazard assessment, decision-making and emergency response, CKC officers must be experienced geotechnical experts within an institutional culture that promotes knowledge, know-how, professionalism and long-standing commitment. A level of hierarchy and promotion within the department that encourages CKC officers to become geotechnical experts and better slope managers needs to be explored.

ON COMMUNICATION WITH SLOPE-RELATED STAKEHOLDERS

While the reception towards NSMP initiatives are well-accepted by the government agencies and other stakeholders during the ICSM meetings, CKC laments that after the sessions, it is difficult to elicit any form of feedback or response from the agencies when following up on the measures agreed upon in the ICSM session. The ability to follow up and elicit results is especially critical for agencies concerning disasters and public safety. For this reason, CKC would like to have the powers of an agency that has statutory powers to follow up and enforce measures regarding slope safety and management. At the same time, CKC realises that the set-up of such an agency can be viable only when the economic and financial climate in the country is more favourable.

ON A DEDICATED UNIT FOR NSMP PROMOTION

In the meantime, CKC recognises the need for a dedicated unit to not only monitor the progress of NSMP implementation but to take a more active role in pushing and promoting the measures recommended in the NSMP. It also acknowledges the fact that many stakeholders are not aware of the NSMP, including those within JKR itself and that more action needs to be taken to better disseminate its contents. Only then can the Malaysian populace—public, private and civil—move towards a comprehensive slope safety system by the year 2023.

STAKEHOLDERS IN THE SLOPE SECTOR

During the numerous feedback sessions held for the revision of this Master Plan, stakeholders articulated what they thought would be instrumental for the slope sector to move forward. They provided a wishlist of suggestions and comments, which have been summarised here.

POLICY AND INSTITUTIONAL FRAMEWORK

Many stakeholders held the view that the NSMP should be the guiding document for slope management for the country, and CKC to be managers of NSMP to lead and guide stakeholders in this sector. They believed that there must be clear legal rules and regulations as well as standard guidelines to achieve systematic and standardised management of slopes. Some believed that having clear legal provisions on slope management would lead to better enforcement by front-line agencies, such as the local authorities.

To cater to the demand for geotechnical expertise in the country, more skilled staff, experienced and trained engineers, and experts on slope management are needed. In landslide-prone areas, the setting up of slope units in local authorities should be required. To spread awareness, better and improved involvement of the public and NGOs should be encouraged.

They also encouraged shared responsibility and costing among stakeholders through coordination and cooperation, including private owners of properties. However, for public mitigation and rectification measures, there must be sufficient funds and grants to initiate these measures.

Finally, they stated the need for improved and clearer legislation to support the set-up and running of emergency response team structure (in addition to the MKN protocol).

HAZARD MAPPING AND ASSESSMENT

Local authorities and emergency first responders said that they would like to have access to hazard and risk maps of areas within their jurisdiction so that they can plan and execute mitigation, rectification, and response measures more effectively. Communities should also be aware of risky areas within their vicinity to better prepare for landslide emergencies, and government agencies should engage more in risk communication to the public.

TRAINING

Practitioners and academicians both highlighted the need to improve the basic understanding in soil mechanics during undergraduate studies. These topics are normally considered the most challenging for civil engineering students to understand. Unlike steel or concrete for which mechanical properties are easily characterised, soil which is rarely homogeneous and has mechanical and hydraulic properties that vary with several factors such as soil or rock type, effective stress history, rate of loading and degree of saturation. During the first NSMP study, it was concluded that most man-made slopes failed due to design errors, especially in determining the right soil parameters and method of analysis. Advanced topics such as critical state soil mechanics, unsaturated soil mechanics and rock mechanics need to be introduced in order for a civil engineer to be able to interpret laboratory tests and conduct complete and proper analysis of soil and rock slopes.

Currently, in addition to geology and soil laboratory, 6 credit hours is being allocated to cover soil mechanics and geotechnical engineering in the local universities. After discussions with the universities, it has been concluded that increasing the credit hours for geotechnical engineering related subjects would not be possible as there are many other civil engineering disciplines that need to be covered. Alternatively, subjects like advanced soil mechanics, foundation engineering, slope engineering and even slope management could be offered as electives for final year and post graduate students. The syllabus for geology, soil mechanics and geotechnical engineering could also be reviewed such that some advanced topics in slope engineering could be introduced in a creative manner so that these concepts could be easily understood by undergraduate students. It is hoped that by doing so would encourage engineers to pursue further knowledge in these subjects when they practice.

LANDSLIDE PREVENTION MEASURES (LPM)

Rather than establishing more guidelines related to slopes, many stakeholders highlighted the need for these guidelines to be coordinated and harmonised. Currently, Selangor, Kuala Lumpur and Penang have different hillside development guidelines. Kota Kinabalu has recently introduced their own version, which is a combination of Penang and Kuala Lumpur guidelines. These guidelines differ, especially in the buffer zone requirements, causing confusion among the stakeholders during implementation. Engagement from all relevant stakeholders is crucial in establishing guidelines that affect the nation. For this purpose, all stakeholders agreed that CKC would be the best agency to coordinate the overall preparation of development, design, construction and maintenance guidelines for slopes which will be implemented nationwide. Practitioners have also expressed their interest to assist in the preparation of guidelines that greatly impact their profession.

It is important that development and design guidelines be more comprehensive, providing clear provisions on roles, tasks, duties and obligations by stakeholders, instead of just specifying the factor of safety and buffer zones. During the meeting with stakeholders, it became obvious that the role of geologists and engineers need to be clearly spelled out in the development, design and construction guidelines.

There is a critical need to introduce new policies, regulations and institutional framework to support a new and harmonised set of guidelines. For example, new policies and regulations need to be in place to resolve issues with standing supervision by consulting engineers, and establish the roles and responsibilities of independent checkers. Additional staff, engineers and checkers are required for the local authorities and JKR to review development proposals, monitor construction works and carry out maintenance activities. At the later stage of the NSMP, sustainable slope practices should be encouraged. Guidelines on sustainable slopes, which encourage not only green slopes but also designs that are maintenance and environmental friendly, as well as construction methods with lower carbon footprint, need to be established.

To ensure the establishment of a proper framework and the preparation and maintenance of these guidelines, a working committee and a number of sub-committees will need to be formed at the federal, state and district levels.

Addressing and rectifying old slopes require a different approach from that for new slopes. Having the right framework and necessary guidelines would only take care of the new slopes. Actions are also required on the old slopes, especially those prior to the setting up of the One Stop Centre (OSC) under the local authorities in the year 2000 to vet through development proposals (pre-construction phase). Repairing a failed slope would be costly compared to strengthening an existing slope. The current approach of 'fire-fighting' is ineffective and would cost the nation a lot more in the future. As such, in addition to the allocation needed for repairing failed slopes, additional budget should be invested in preventive works or proactive measures, i.e. slope maintenance activities and retrofitting of existing man-made and natural slopes.

After much discussion with stakeholders, it was concluded that disincentive schemes have been not practical or workable. For example, only BEM could de-register a professional engineer, but could only do so upon a court decision. The judicial process is a long and expensive process. Therefore, incentives in the form of awards and acknowledgements to individuals or companies that have contributed to slope engineering and management should be established.

It would be beneficial to practitioners to be updated on the latest development in slope engineering technology. Various methods of topographic survey, geophysical survey, slope strengthening, rock fall counter measures, geotechnical sensors, data loggers and data transmission are being rapidly developed by many parties. As such, a platform should be established in the form of a special interest group (SIG) to share information and discuss the latest technologies, trends and developments.

RESEARCH AND DEVELOPMENT

Many of the issues raised for the R&D component were related to insufficient funding, not enough data/result sharing, absence of a centralised research network, poor collaboration between university-industry, unstructured fundamental research, poor communication and coordination between scientists and practitioners, as well as low visibility and impact of local research in regional and international platforms.

There was major consensus among the stakeholders to increase the number of research funding (international and government) for fundamental and applied research projects that lead to field application and commercialisation.

In turn, funding agencies stated that they would like to receive a list of research topics or research agenda for slope engineering and management so that research can be carried out in an integrated manner and following national and sector vision and goals. Most researchers hope that JKR or a newly established slope agency will coordinate the research activity by providing more platforms for sharing knowledge and disseminating research finding. They also hope that this centralised agency shall communicate with international and national funding agencies on slope-related research topics, problems, issues and possible solutions. Within the research community a national slope research agency network should be collaboratively set up, disseminated and actively maintained. It must be supported by SIGs, which promote multi-, inter- and trans-disciplinary approaches to disasters.

Given the limited funding available from the Government or international funding institutions, it was suggested that industry stakeholders, e.g. technological inventors, industry players, developers, contractors, and donors, collaboratively set up a public-private funding or trust fund. A very minimal levy can be imposed upon aforementioned parties that are involved in the slope industry or any slope related projects. A trust fund can be used later to financially support high-impact research activities that can be very beneficial to the country's slope industry. Gifts, donations or endowments can be contributed to the trust fund and extended to education, training, or any capacity building program. Scientists, practitioners and professionals are called to work together for solving real problems in the country's slope industry.

An integrated technological research on the slopes or sediment-related disasters shall be promoted with modern and advanced technologies, which ranges from mapping, monitoring and characterisation to monitoring, modelling and prediction. It covers many remotely-sensed technology such as space-, air-, ground-, and underground-based sensors to quantify the slope geomorphology processes, activities and causes. Experimental, simulation and observation of different types of slope materials are encouraged with the support of JKR or its research institution in the near future.

EXPERT PANEL ON SLOPE MANAGEMENT

In 2014, the Construction Industry Development Board (CIDB) and the Ministry of Housing and Local Government held a seminar on slope management called “Overcoming Challenges & The Way Forward”. Unlike other technical seminars on slopes which mainly focused on slope engineering techniques and methods, this seminar focused on issues and challenges that impeded more effective and smoother implementation of slope management throughout the country. In this issues-driven session, participants of the seminar including engineers, government agency personnel, planners, local authorities, and state agency personnel, were invited to identify impediments in the slope sector. At the end of the seminar, the impediments were addressed as ‘resolutions’ by a panel of speakers comprising CKC, member of the public and slope owner, Ministry of Housing, Majlis Perbandaran Ampang Jaya, a barrister and solicitor of the High Court of Malaysia, National House Buyers Association, an industry practitioner, and a non-governmental organisation. These resolutions, articulated two years ago, are as relevant and valid today as they were then.

RISK MANAGEMENT / INSTITUTIONAL FRAMEWORK

- Mandatory OSC setup with geotechnical input to be set up at local authorities in hillside areas
- Make it compulsory under the law for a Geotechnical Accredited Checker, as an independent checker to check and verify that slope design and construction are safe and done to the best engineering practises.
- Not well defined in the Selangor and KL guidelines. When to need checker and when not to need. Which category require an independent checker, and what is the extent of the checker's involvement during construction.
- Retrofitting of old, pre-guideline or doubtful slopes to be national focus
- Local authorities to better understand their responsibilities in approving slope developments
- Review slope-related designs not only confined within the boundaries of the project, but within the surrounding areas
- Form a slope technical committee at the state level in each state to go through all slope development plans as recommended in the KPKT's Garis Panduan Perancangan Pembangunan Tanah Tinggi
- Improve and simplify the current guidelines on hillsite development with safety enhancement
- Ensure that two or more phased planning approvals/development orders are given for hillslope developments, wherein all infrastructure, especially drains, erosion control, and slope stabilization measures be completed first to the satisfaction of the local authority before planning approval is given for the construction of any building in the development
- To immediate gazette all remaining hillslopes, including hillslopes that are still state land under the Land Conservation Act, National Land Code and the Town and Country Planning Act. To look into the financial viability of enquiring back all undeveloped hillslope land
- Stop overdevelopment of hillslope areas
- Consider a new comprehensive law on hillside development after HK's building ordinance
- Amend rules to act against unqualified slope builders (short-term)

CONSTRUCTION

- More site supervision
- Immediately discontinue hillslope projects that do not meet the requisite criteria for safety as prescribed under current legislation
- Need to consider more environmental-friendly slope solutions

MONITORING

- Slope owners (private and public) to conduct frequent checks
- Local authorities to be more engaged with community monitoring groups. Communities take more collaborative approach with local authorities
- Identify the number of hillside projects (past, current and future) that have been completed, are ongoing or may be in the future undertaken by developers
- Hillside development technical committee to be formed at all levels of authorities Periodical monitoring settlement survey (include 3D) using GPS with photographs taken as well as periodical visual inspection by geotech engineers who can recognize early hillslope fatigue or distress

MAINTENANCE

- Engineered slopes to have a maintenance schedule and log
- Workchart and bi-annual maintenance program made mandatory and impose on developers of hillside development
- Make it compulsory under the law for slope owners to appoint Professional Engineers to inspect slopes on a certain regular basis, and to rectify defectives, if any
- Identify proper drainage system on private lands and its surrounding areas for water flow management

ENFORCEMENT

- Find ways to force private slope owners to manage their slopes
- Require compliance to slope guidelines

RISK MANAGEMENT / INSTITUTIONAL FRAMEWORK

- Slope owners to **insure their slopes** against any failure
- **Set up a Centralised Body** to support the 149 local authorities on new hillside developments and to strengthen old and doubtful existing slopes
- Ensure that **development and assessment charges are sufficiently high enough to cover long-term infrastructure maintenance of** slopes
- **Approval of a special budget**
- **Uniform procedures with all local councils**
- Start thinking about setting a limit to the **duration of liability of engineers.** E.g., 15 years? 20 years? Or should there be **professional engineers' insurance?**
- **Malaysia geotechnical engineering office modelled** after GEO Hong Kong
- **All insurance companies offering general insurance cover** risk of landslides, soil or flooding in the hillslope areas
- To make it **mandatory that all developers make available to** all Purchasers for development on hillslope property the following prior to purchase:
  - Approved layout plan
  - A copy of the Development Order/Planning Approval and Development Impact Report
  - Developers' signed undertaking that they had complied with all relevant guidelines on hillslope development
- Availability of insurance for landslides
- Estimated cost of hillslope maintenance for the development, which will have to be paid for by Purchasers once they take over management or individual title is issued
- Create more awareness of risks inherent in hillside living among homeowners and homebuyers
- Developers to contribute a lump sum towards a hillside maintenance fund for their hillslope development
- Make it mandatory of hillside owners to contribute towards a maintenance fund
- Set up of a Unit Cerun at the state level
- Need a special fund for stabilising slopes
- Local authorities to streamline slope unit in terms of scope, function, logistics
- Technical information needs to be more complete

WISHLIST FROM COMMUNITIES

In line with the Eleventh Malaysian Plan's aspirations for an inclusive society, strategies in the Master Plan have been crafted with inputs from members of the public as well as from officers within government agencies. During a dialogue session between JKR and the communities of Ulu Klang (a hillside suburb known for its history of landslides) in 2014, the residents' comments, concerns, suggestions, and insights for safer slopes were noted by JKR. As communities are usually end-users of the slopes built around them, their input is important towards the crafting of strategies that are equitable to all members of society.

COMMENTS FROM THE PUBLIC

JKR TO CONTINUE ENGAGEMENT WITH THE COMMUNITIES.

The residents said joint solution-finding sessions with JKR is very constructive. They would like to have more of these kinds of sessions if possible. They stated that they enjoy communication with authorities such as JKR so that they can be better informed about their surroundings.

The two-way communication nature of the dialogue between the authority and the people who are affected made the residents feel that they are contributing to the greater good of society.

Social media is a good platform for communicating, but the question of who is the source is important. Online communication is good for educating the public. But ultimately, it's not so much the channel or mode of communication, but more importantly, 'who' is the source that counts. Experts are important, and information from the experts is preferred.

MORE RISK COMMUNICATION

It is important to provide education to the public on the risks of living in hillside development. If residents and potential home buyers are aware of the risks of landslides, they can make better choices and trade-off decisions on whether to reside in hillside areas. Among those who currently live in hillside areas, many said they were not aware of the risks when they first moved in. Further discussion revealed that those who go through the process of weighing the risks and benefits and still choose to live in hillside areas are more willing to invest in mitigation measures. Thus, it behooves developers, slope managers and local authorities to engage more in risk communication.

EMPOWER COMMUNITIES WITH KNOWLEDGE

A sense of control or influence over one's environment leads to better disaster preparedness and resilience. One of the ways to gain control is to be able to report signs and request mitigation or repair measures. Another way to gain a sense of control over one's environment is to actively engage in slope maintenance and ensure that local authorities and other slope owners do so as well. Residents are now aware that even though a slope is designed well, maintenance is needed to keep it safe. Residents are also aware that slope developments can affect the condition of the adjacent lots or areas, so residents also feel that developers need to consider the surrounding environment and not only the project site.

NEED FOR MORE EDUCATION ON SLOPES

In discussions with community members, it became evident that in spite of the awareness and education that was carried out, there were still misconceptions that needed to be dispelled. One of the persistent misconceptions is the belief that natural slopes are always safer than engineered ones. They believe that any engineered slopes are more dangerous than natural slopes. This indicates that there must be more public awareness and education to be carried out in the future.

MORE INFORMATION, MORE FEEDBACK, MORE ENGAGEMENT

During the dialogue session, the residents became more engaged as stakeholders and wanted to know whether the initiative for which they were being questioned would be followed through. They said they would like to know the outcome of the study on which they were being surveyed. They enjoyed the engagement with the authorities (i.e. JKR) and would like similar workshops in the future.

They also stated that they enjoy communication from authorities such as JKR so that they can be better informed about their surroundings.

And finally they wanted CKC to create and foster more two-way communication between people staying in risk areas and the authorities so that slope safety becomes a collaborative effort.

"If the issue is involving lives, the public should be involved. At the moment, we don't feel like we are. This session is good. The inputs we give could be useful, to help create policies."

APPROACH

- APPROACH TO THE MASTER PLAN REVISION
- INCORPORATING SUSTAINABILITY INTO SLOPE MANAGEMENT

APPROACH TO THE **MASTER PLAN REVISION**

The goals and objectives of the Review of the NSMP 2016 were crafted to align themselves to the national strategic plans. By aligning with the national guiding principles and agendas, a 'top-down' approach to master planning satisfied the need to incorporate current social, political, environmental and economic perspectives. It prevents the NSMP from becoming a standalone document and ensures cohesion with the country's national objectives.

At the same time, a 'bottom-up' approach ensures that the needs and wishlists of implementing stakeholders and the public are considered.

The guiding frameworks or plans are referred to in the NSMP revision are:

- Eleventh Malaysia Plan 2016-2020
- JKR Strategic Plan 2016-2020
- Sendai Framework for Disaster Risk Reduction 2015-2030
- United Nations' Sustainable Development Goals

The revision process also considered the strategic plans of 'sister' organisations such as the Construction Industry Development Board's CITP 2016 (Construction Industry Transformation Plan).

By aligning itself with all four guiding frameworks, agendas, and plans, the revised NSMP ensures cohesion with international and national-level objectives and goals.

Eleventh Malaysia Plan 2016-2020

The Eleventh Malaysia Plan 2016-2020 is the final leg in the journey towards realising Vision 2020. The development of the Eleventh Plan was guided by the Malaysian National Development Strategy (MyNDS), which focuses on rapidly delivering high impact on both the capital and people economies at low cost to the government. The capital economy is about Gross Domestic Product (GDP) growth, big businesses, large investment projects, and financial markets, while the people economy is concerned with what matters most to the people, including jobs, small businesses, cost of living, family wellbeing, and social inclusion.

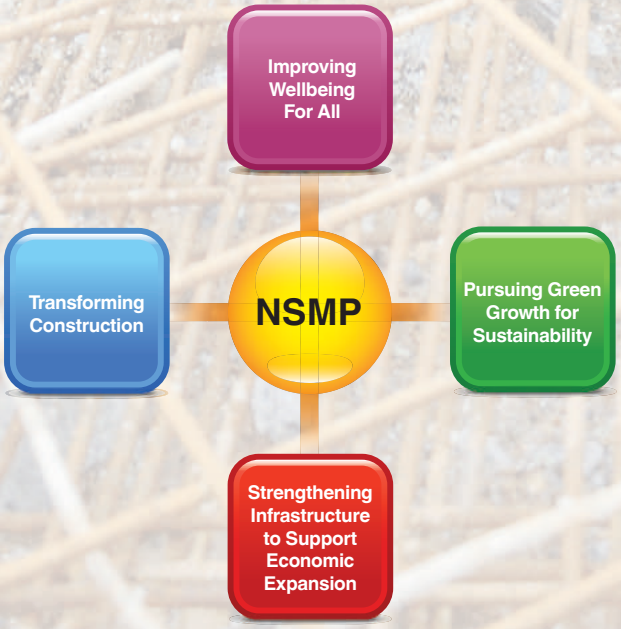
Accordingly, the Eleventh Plan is a strategic plan that paves the way for Malaysia to deliver the future that the rakyat desires and deserves. It represents the Government's commitment to fulfilling the aspirations of the people.

The Eleventh Plan, based on the theme "anchoring growth on people", has six strategic thrusts and six game changers for transforming ideas into reality and addresses the goals set out in Vision 2020, in which Malaysia achieves the end state of having an advanced economy and being an inclusive nation.

Relevance of the Eleventh Malaysia Plan to the NSMP

There are four thrusts in the Eleventh Malaysia Plan that could apply to the NSMP. These are:

- **Thrust 2:**
  Improving Wellbeing for All (safer environment)
- **Thrust 4:**
  Pursuing Green Growth for Sustainability (strengthening disaster risk management; enhancing awareness for shared responsibility; adopting the sustainable consumption and production concept)
- **Thrust 5:**
  Strengthening Infrastructure to Support Economic Expansion (better slope construction)
- **Thrust 6:**
  Transforming Construction (fostering sustainable practices)



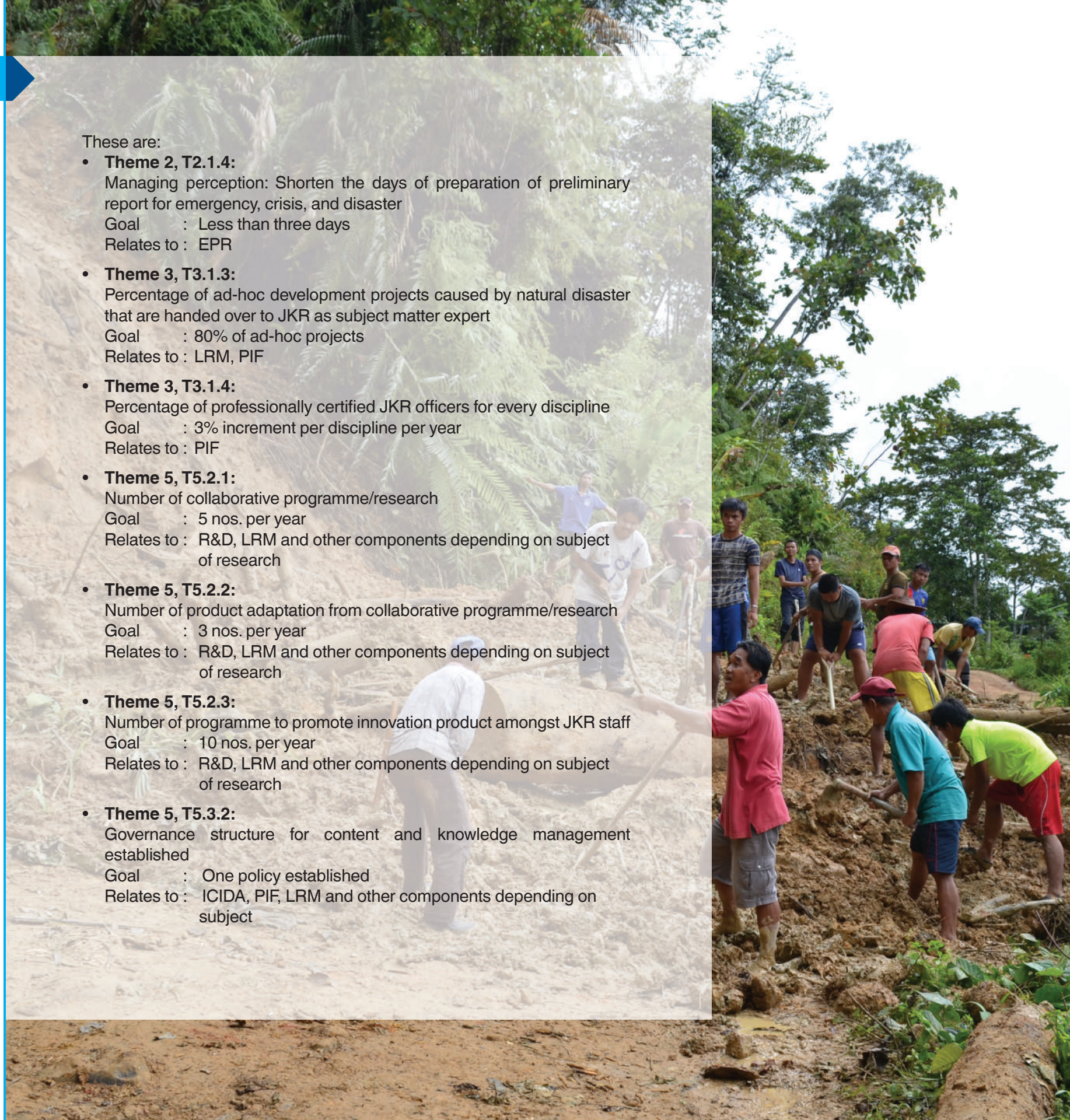
JKR Strategic Plan 2016-2020

The thrusts of the JKR Strategic Plan 2016-2020 are derived from the Economic Transformation Program (ETP) in the areas of world-class infrastructure, new industries, sustainability, environment conducive to quality living, and world-class human capital. These are then translated into five themes or priority areas for all departments within JKR.

The Strategic Results of four of these themes can apply to the NSMP, and these are JKR as Co-Creative Customer Experience (Theme 2), Technical Reference Centre (Theme 3), Sustainable Infrastructure (Theme 4), and Innovative Organisation (Theme 5).

Relevance of JKR Strategic Plan to the NSMP

Each thrust has measures in the Director General's Scorecard that are specifically relevant to the NSMP and should be incorporated into the plan.



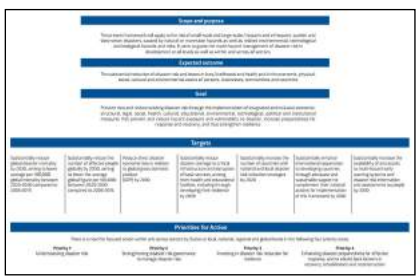
These are:

- **Theme 2, T2.1.4:**
  Managing perception: Shorten the days of preparation of preliminary report for emergency, crisis, and disaster
  Goal : Less than three days
  Relates to : EPR
- **Theme 3, T3.1.3:**
  Percentage of ad-hoc development projects caused by natural disaster that are handed over to JKR as subject matter expert
  Goal : 80% of ad-hoc projects
  Relates to : LRM, PIF
- **Theme 3, T3.1.4:**
  Percentage of professionally certified JKR officers for every discipline
  Goal : 3% increment per discipline per year
  Relates to : PIF
- **Theme 5, T5.2.1:**
  Number of collaborative programme/research
  Goal : 5 nos. per year
  Relates to : R&D, LRM and other components depending on subject of research
- **Theme 5, T5.2.2:**
  Number of product adaptation from collaborative programme/research
  Goal : 3 nos. per year
  Relates to : R&D, LRM and other components depending on subject of research
- **Theme 5, T5.2.3:**
  Number of programme to promote innovation product amongst JKR staff
  Goal : 10 nos. per year
  Relates to : R&D, LRM and other components depending on subject of research
- **Theme 5, T5.3.2:**
  Governance structure for content and knowledge management established
  Goal : One policy established
  Relates to : ICIDA, PIF, LRM and other components depending on subject

- **Theme 5, T5.4.1:**
  Percentage of Innovation Competency Model development (creativity, enterprising, integrating perspective, forecasting, managing change) (Innovative Human Capital)
  Goal : 100%
  Relates to : All components depending on subject
- **Theme 5, T5.4.2:**
  Percentage of Innovation Competency Model development (creativity, enterprising, integrating perspective, forecasting, managing change) (Innovative Information Capital)
  Goal : One no. per domain
  Relates to : All components depending on subject
- **Theme 5, T5.4.3:**
  Number of innovative and research related programme organised
  Goal : 12 nos. per domain
  Relates to : All components depending on subject

There were no targets set for sustainability of slope construction in the Strategic Plan.

Relevance of JKR Strategic Plan to NSMP: Certain JKR targets can be incorporated into the NSMP



Sendai Framework for Disaster Risk Reduction 2015-2030

The Sendai Framework for Disaster Risk Reduction 2015-2030 is the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015. It continues the international initiative to reduce damage to life and property due to disasters, including landslides. There are seven goals and four priorities for action. As slopes and landslides are considered Malaysia's number 2 disaster, it is crucial to refer to this framework for landslide risk reduction.

The Sendai Framework provides the basis for the revised NSMP strategy structure. Although its Priorities for Action are aimed towards disaster risk reduction, it is flexible enough to cater for socio-economic targets as well.

The Sendai Framework Priorities for Action are as follows:

- **Priority 1**: Understanding disaster risk
- **Priority 2**: Strengthening disaster risk governance to manage disaster risk
- **Priority 3**: Investing in disaster risk reduction for resilience
- **Priority 4**: Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction.

These priorities for action gave impetus for the development of the revised NSMP thrusts, as shown in the next chapter.

Relevance of Sendai Framework to NSMP: All Priorities for Action apply to the NSMP

United Nation's Sustainable Development Goals

The Sustainable Development Goals (SDGs) is a United Nation initiative which harks back to 1975 to improve the standard of living for citizens worldwide through poverty eradication, energy, water and sanitation, health and human settlement. It was later amended to include sustainable development, resulting in the Official Agenda for Sustainable Development called "Transforming Our World: The 2030 Agenda for Sustainable Development with 17 Sustainable Development Goals (SDGs)". Four of these goals are directly impacted by landslides: 3) Good Health and Wellbeing; 9) Industry, Innovation and Infrastructure; 11) Sustainable Cities and Communities; and 13) Climate Action.

- **Goal 3** Good Health and Wellbeing: 'Wellbeing' can be defined as a sense of security and peace of mind in a domicile that is free of landslide hazards
- **Goal 9** Industry, Innovation and Infrastructure: Engage in sustainable slope development practices
- **Goal 11** Sustainable Cities and Communities: Create safer cities through safer slopes
- **Goal 13** Climate Action: Take urgent action to combat climate change and its impacts

Relevance of SDGs to NSMP: Alignment of NSMP to four SDG goals

Alignment with Master Plans of Related Sectors

CIDB has recently released its new master plan, called the Construction Industry Transformation Programme (CITP) 2016-2020. It is apt that it has come up with a new edition to the 2005-2015 Master Plan, as the construction sector has been highlighted in the Eleventh Malaysia Plan as one of the strategies under Strategic Thrust 6: Re-Engineering Economic Growth for Greater Prosperity. The strategy, Transforming Construction, calls for enhancing knowledge content; driving productivity; fostering sustainable practices; and increasing the internationalisation of construction firms.

To be in line with these goals, the CITP has four thrusts:

Quality, Safety and Professionalism

Involves the application of a quality measurement tool for assessing the quality of buildings (QLASSIC), reduction in the number of fatalities due to construction accidents, and address poor working conditions of the labour force

Productivity

Promotes the use of an Industrialised Building System (IBS) construction and Building Information Modelling (BIM)

Environmental Sustainability

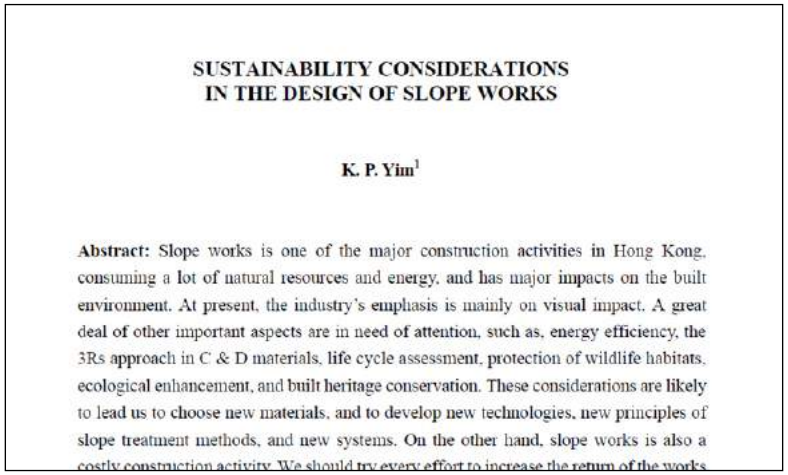
Explores ways to convert construction waste into revenue-generating materials, creating sustainability ratings for construction, reducing carbon released in the construction life cycle, and conducting applied research on sustainability in construction such as affordable housing and peat soil engineering

Internationalisation

Looks into how the Malaysian construction sector can compete with foreign companies in the international scene and getting more local construction players to participate in the STAR rating system

Relevance of CITP to NSMP: Exploring how environmental sustainability for construction can be applied to slopes

INCORPORATING SUSTAINABILITY INTO SLOPE MANAGEMENT



SUSTAINABILITY CONSIDERATIONS
IN THE DESIGN OF SLOPE WORKS

K. P. Yim[1]

Abstract: Slope works is one of the major construction activities in Hong Kong, consuming a lot of natural resources and energy, and has major impacts on the built environment. At present, the industry's emphasis is mainly on visual impact. A great deal of other important aspects are in need of attention, such as, energy efficiency, the 3Rs approach in C & D materials, life cycle assessment, protection of wildlife habitats, ecological enhancement, and built heritage conservation. These considerations are likely to lead us to choose new materials, and to develop new technologies, new principles of slope treatment methods, and new systems. On the other hand, slope works is also a costly construction activity. We should try every effort to increase the return of the works

At the outset of the study, one of the requirements was the inclusion of sustainability as one of the components of the NSMP. This required coming up with a definition of 'sustainability' as it relates to slopes, and how it would tie into slope management. After a review of literature on sustainability and slopes, the best definition came from a paper written by the Architectural Services of the Hong Kong Special Administrative Region. This section is drawn largely from this source.

The cutting and construction of slopes affects the landscape of the land, affecting not only the form and shape of the terrain itself, but the flora and fauna inhabitants of the forests and jungles within the hills as well as the impact of slope construction upon the human built environment.

Thus, sustainability should include the engineering profession that is responsible for the design and construction of slopes, the construction sector, slope owners and the community at large to strike a good balance between the technical, social, economic and environmental components of sustainable slopes.

DEFINITIONS

Sustainable Development

The Brundtland Commission (1987 World Commission on Environment and Development) defined Sustainable Development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'.

Hong Kong Planning Department's definition of sustainable development:

> *Sustainable Development in Hong Kong balances social, economic, environmental and resource needs, both for the present and future generations, simultaneously achieving a vibrant economy, social progress and a high quality environment, locally, nationally and internationally, through the efforts of the community and the Government.*

It covers areas including economy, health and hygiene, natural resources, society and social infrastructure, biodiversity, leisure and cultural vibrancy, environmental quality and mobility.

Sustainable Engineering Design and Construction

Sustainable engineering design and construction, including slope works, is a global trend. It is about strengthening and, wherever relevant, introducing environmental, socio-cultural and economic values into the practices of building and construction, including slope works, in a balanced act and with a view to achieving sustainable development.

It is important not to confuse it with the concepts of 'sustainable construction' and 'green construction'. The concept of 'green construction', where only environmental issues (i.e. the environmental impacts of building and construction) are considered, is much narrower than the concept of 'sustainable construction'. The definition of sustainability goes broader than this to include, for example, contribution to economic growth and employment, cultural heritage, and health and safety.

Sustainable Slope Works

Essentially, sustainable slope works is about minimising the negative impacts and maximising the positive impacts to achieve a balance in terms of environmental, economic and social performance. Some of the specific areas of concern are value management, life cycle assessment, more energy-efficient designs, abatement of environmental nuisance during construction, reduction and management of construction and demolition materials, and built heritage conservation, among others.

Criteria

A set of sustainability considerations pertinent to sustainable slope works design is identified as below:

- Value for money
- Blending works with surroundings and minimisation of disturbance to natural terrain
- Energy efficient design
- Reduction and utilisation of waste materials
- Protection of wildlife habitats
- Built heritage conservation
- Increasing rate of return
- Life cycle assessment

Value for money - Value Management (VM) or Value Engineering

Blending works with surroundings and minimisation of disturbance to natural terrain - Gradual reduction of shotcrete, increased use of netting, vegetation, eco-engineering approach such as continuous fiber reinforced soil method (Geofiber), and trend towards reinforced fill embankments

Energy efficient design - Good designs such as sloping berms reduces the need for vertical drains and hence increases energy efficiency

Reduction and utilisation of waste materials - Recycled materials to be used as slope construction material

Protection of wildlife habitats - Slopes with habitats for wildlife built in or promoted

Built heritage conservation - Engineering to preserve heritage sites rather than to demolish or cut them

Increasing rate of return - Use of slopes as assets and revenue generating, e.g. slope advertisement, solar energy panels, powered irrigation system, grass skiing, ecological trails, rock carving, and slope farming

Life cycle assessment - Life-Cycle Assessment/Analysis (LCA) impacts consider embodied energy (EE), which is related to fossil fuel depletion, CO_2 for global warming, SO_2 for acid rain, and dust for air pollution. It facilitates building designers in making decisions on alternative options in material use as well as building services systems

Relevance of Hong Kong Sustainable Slope Practices to NSMP: All of the above

PHASES

- PHASES OF NSMP IMPLEMENTATION
- PHASED PRIORITISATION OF NSMP THRUSTS

PHASES OF **NSMP IMPLEMENTATION**

The strategies and action plans of the revised NSMP shall be implemented in phases. There are seven years left for the implementation period of the NSMP, which are split into two phases.

Rationale and Framework for Prioritisation

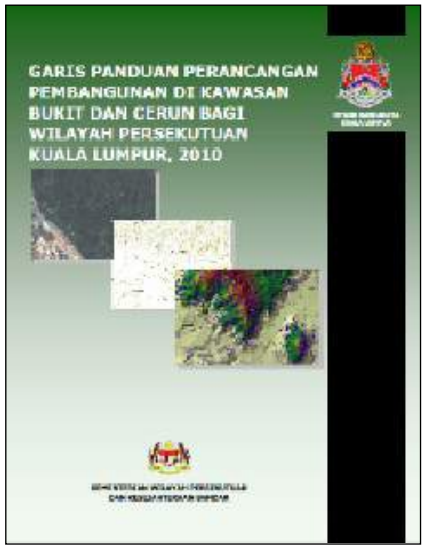
The NSMP implementation is based on the Hong Kong Geotechnical Engineering Office (GEO)'s phased roll-out plan of its strategies, which was created in the mid-1970s. Back then, it was deemed as a methodical approach to stem the tide of devastating landslide disasters Hong Kong was facing at the time. Eventually, the stopgap measures that the Civil Engineering and Development Department took to control the situation evolved to become a phased implementation plan of long-term strategies that would cover 40 years of slope management direction and become to be known as the Hong Kong Slope Safety System.

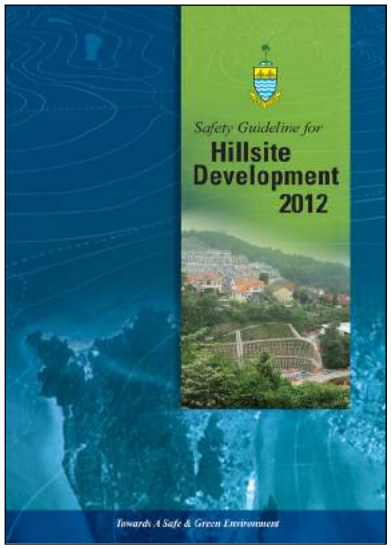
Similarly, the State of Selangor declared a moratorium on all new slope development approvals following the Bukit Antarabangsa landslide in 2008. Approval for all slope developments in Selangor was halted, amidst much media coverage and anger by the public over the apparent lack of oversight and control in slope management within the country. Forensic reports indicated that one of the causes of the landslide was due to substandard slope engineering practices; it was also the reason for the rash of landslides that Hong Kong had experienced during the '70s. The similarities in the geology and the practices carried out along the Ulu Klang section of the Titiwangsa Range were confirmed by Dr. Andrew Malone, a former GEO director, in his presentation at the Asian World Summit's 2nd Asian Metropolitan City Summit held in Kuala Lumpur in 2014, who stated that slopes in Ulu Klang were built using similar construction practices in pre-1977 Hong Kong.

Following the moratorium, the next step that the Selangor State Government took was to form a Selangor State Committee on Hillside and Highland Development (*Jawatankuasa Teknikal Pembangunan Kawasan Tanah Tinggi dan Lereng Bukit Negeri Selangor*). The Committee, together with relevant government agencies, drafted a set of guidelines called the "Planning Development Guidelines on Hilly and Highland Areas for Selangor State" in November 2009.

In similar fashion, two other states with high-risk slopes, Wilayah Persekutuan and Penang, also drafted and formalised planning development guidelines for their own states, in 2011 and 2012 respectively.

Guidelines on hillside development for the states of Selangor, Wilayah Persekutuan and Penang





As the trajectory of disaster experiences and the development of subsequent actions and measures in both locales are similar, the phased prioritisation of strategies for Malaysia shall be similar to that of Hong Kong, albeit with some differences.

For the Hong Kong prioritisation plan, the beautification and sustainability of slopes was the focus of its third phase of implementation. However, as sustainability is an item of major significance in almost all of the current national agendas and plans in Malaysia, the implementation for sustainable slopes shall start in the first phase rather than in latter phases.

Hence, the phased prioritisation shall have two phases to cover the remaining seven years of the NSMP.

Phased Prioritisation of NSMP Thrusts

There are now two phases of the NSMP, namely Phase 1: Setting Standards and Promoting Good Governance and Phase 2: Reducing Risks.

To summarise the objectives of the phases:

- **Phase 1** can be viewed as strengthening human capital of slope industry players in the public and private sectors, and
- **Phase 2** as focusing on the structural and non-structural aspects of slope management.

Phase 1. Setting Standards and Promoting Good Governance (2017-2018)

This two-year phase is aimed towards the standardisation and uniformity of guidelines, procedures, protocols, agendas, codes, data formats and other information to be used by slope managers, practitioners and researchers, all for the purpose of better coordination and management of activities and facilitating data sharing.

One of the initiatives is to make CKC a central repository of all data and information related to slopes. This includes slope reports, hazard maps (private and public), landslide maps, susceptibility maps and rainfall data. This is in line with JKR's Theme 3, which states that JKR should be a technical reference centre. However, this does require CKC personnel to undergo training to gain the capability to advise. This is also a requirement in Theme 3.

Other activities in this phase include standardised procedures for checking the adequacy of the planning, design, construction and maintenance of all new geotechnical works (private and public) including slope works, site formation, and earth-retaining structure, among others. It also includes adequate legislation and enactments to empower authorities to act on slope risks on private land.

Finally, this activity involves the identification of risk areas, which is done through the creation of hazard and risk maps in high-risk areas throughout the country.

Phase 2. Reducing Risks (2019-2023)

This phase, spanning five years, entails risk reduction measures such as retrofitting high-risk government slopes and/or carrying out routine maintenance activities and implementing risk reduction measures such as retrofitting works, setting up early warning systems, nowcasting and forecasting, as well as carrying out awareness programs.

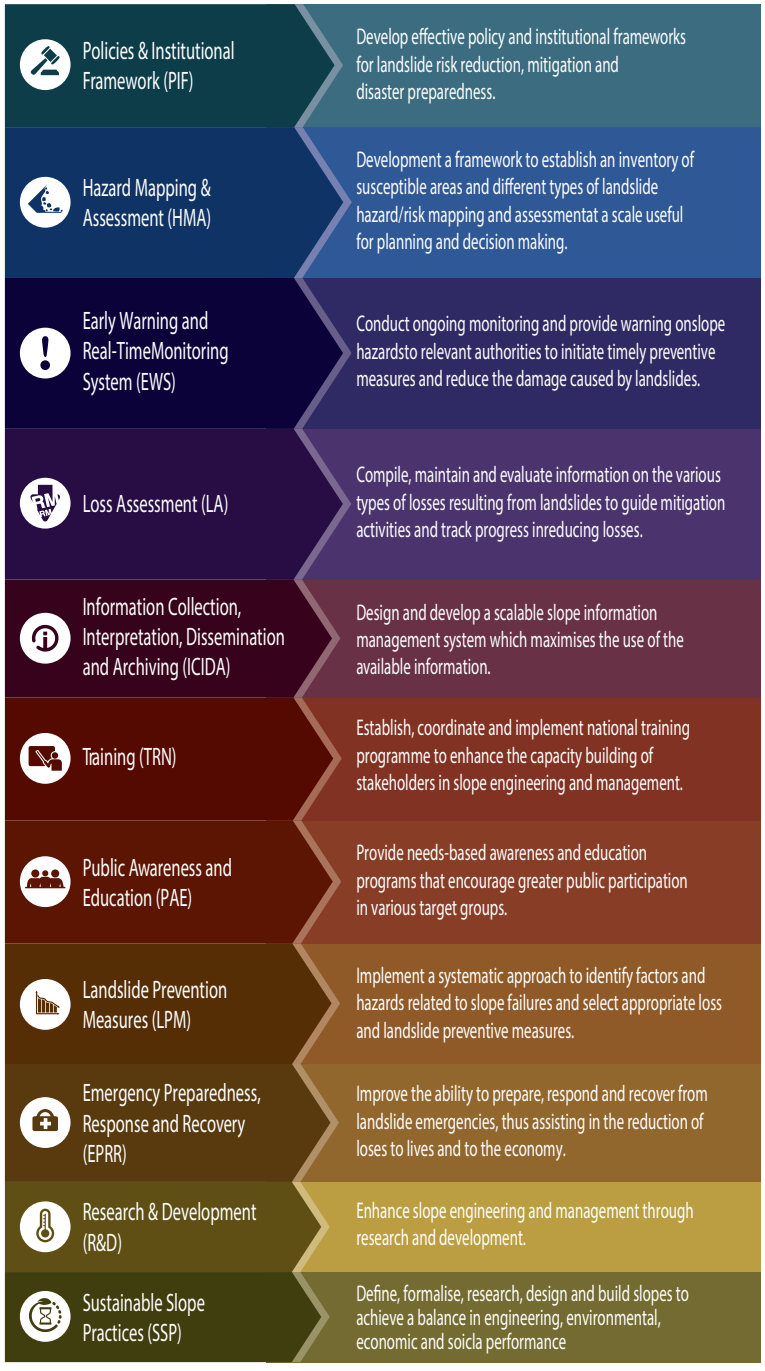
Running throughout both phases, sustainability is highlighted. It includes, but is not limited to, greening and beautification of slopes. This includes application of concepts such as value management, blending works with surroundings and minimising disturbances to natural terrain, energy efficient designs, reduction and utilisation of waste material, and protection of wildlife habitats, among others.

STRATEGIES BY COMPONENT

- STRATEGIES BY COMPONENT
- IMPLEMENTATION SCHEDULE, COSTS AND KPIs BY COMPONENTS
- THE COMPONENTS

STRATEGIES **BY COMPONENT**

Each component of the NSMP addresses slope management from different perspectives, whether it is from a legal, training, research or best practices viewpoint. Altogether, they provide a comprehensive view of slope management issues. Although these perspectives are presented as standalones, in practice they should be implemented in tandem with each other. For example, in order for the Public Awareness and Education component to be effective, best practices (under the Landslide Prevention Measures component) and laws and policies (under Policies and Institutional Framework) must be in place.



Implementation Schedule, Costs and KPIs by Components

The following tables show the phased implementation of the components' strategies, action plans, budgets, and respective KPIs.

KPIs, or key performance indicators, are not be confused with goals, which are the final outcome or end result to be achieved. KPIs are mid-range targets to ensure that the final outcome will be achieved. Thus, in the NSMP, they shall be used as guidelines that CKC managers can use to verify whether they are on target. The final target, or goals, shall be explained in the section 'Slope Management Industry in 2023'.

Overall, the entire revised NSMP implementation from 2017 to 2023 will cost RM 3.2 billion. The bulk of the budget goes to retrofitting and maintenance under the Landslide Prevention Measures component, which takes up RM 2.8 billion. Without retrofitting and maintenance work, the cost of the revised programs and action plans for the remaining seven years of the Master Plan is RM 391 million.

This is slightly below the original Master Plan's cost of RM 867 million for the 15-year plan duration, in which the cost of the remaining seven years would have been RM 433 million. Without the retrofitting and maintenance, the Landslide Prevention Measure budget would be RM 22 million. The component with the next biggest budget is Information Collection, Interpretation, Dissemination and Archiving component at RM 114 million. This is due to the amount of hardware to be procured and systems to be developed, such as Doppler radars and consolidation of several databases into one system for easy access, retrieval and analysis.

The next largest portion of the budget goes Hazard Mapping and Assessment at RM 77 million, followed by Early Warning Systems at RM 72 million.

Policy & Institutional Framework

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000)		KPI
			Phase 1	Phase 2	BY END 2023
			2017 - 2018	2019 - 2023	
1.1	**Operationalise multi-sectoral and integrated slope management mechanisms**				
1.1.1	Establish and maintain coordinating committees on slope management at the national, state and local authority levels	CKC	0	0	Operate at naional state and local level
1.1.2	Identify funding sources and provide budgetary allocation for slope and disaster management	CKC, MOHE	0	0	Framework for funding mechanism. Setup national fund
1.1.3	Explore and adopt innovative methods of sharing and transferring the costs associated with landslide risk reduction and disasters to alleviate the burden on the state	PIAM CKC, ICSM JKR	5,000 0	6,250 0	Appoint consultant to advise on identifying and creating funding mechanism. Mandatory landslide protection.
1.1.4	Set up a network of government departments, local authorities, disaster management agencies, research institutions, disaster management specialists, NGOs, community groups and other stakeholders to augment their capabilities and encourage best practices.	JKR, CKC, all other stakeholders	0	0	JKR as technical reference centre
1.1.5	Co-operate with international agencies for the sharing and dissemination of knowledge in slope and disaster management and for assistance of expertise and resources in slope and disaster management.	KPKT, TCPD CKC, JMG	0	0	JKR as the manager of NSMP
1.2	**Integrate landslide risk assessment and risk reduction planning into development policies and planning at all levels of government and industry**				
1.2.1	Ensure that the planning activities of federal, state and local authorities take into account slope protection and landslide risk reduction.	Slope management: JKR, KPKT, TCPD, LA, DOE, IEM, JMG	0	5,000	All local authorities and states within landslide sensitive areas to have and implement guidelines on slope management or slope management plans and to have engineering units

1.3	**Formulate and amend legislation to support and promote landslide risk reduction**				
1.3.1	Formulate/modify appropriate legislation and guidelines for better slope and landslide disaster management and to improve the professionalism of geologists, especially in the assessment of slope hazards	CKC, JKR	0	0	Formulate national policy on slope management/ development on slopes. Formulate new law on slope management. Key legislation to be amended to include regulations on slope management
1.4	**Build strong capabilities, expertise and networking in slope management**				
1.4.1	Strengthen CKC to become a Slope Engineering Agency including strategic regional centres, with adequate support, capabilities, expertise and power in developing and streamlining slope management activities				CKC to be the managers of the NSMP
		SUBTOTAL	**5,000**	**11,250**	
		TOTAL	**16,250**		

Explanation of Strategies

Operationalise multi-sectoral and integrated slope management mechanisms

2009 explanation: The objective of this strategy is to ensure an integrated and uniform approach to slope and landslide management through the application of the principles of cooperative governance.

Slope management is a shared responsibility fostered through partnerships among the various stakeholders and cooperative relationships between the different government agencies, the private sector and community. Furthermore, slope management is an inter-governmental process, with each level of government playing a unique role and applying a specific set of responsibilities in the process. It is important that the slope management functions normally performed by the various sectors and disciplines in the national, state and district levels should not be duplicated.

Institutional arrangements must enable cooperation and coordination for the promotion and implementation of integrated measures focusing on risk reduction and the development of institutional capacity to provide improved landslide emergency preparedness as well as response and recovery services.

2016 amendment: The word 'operationalise' replaces the word 'propose' to take into account the existing ICSM set-up and to recommended measures to improve and strengthen this strategy.

Integrate landslide risk assessment and risk reduction planning into development policies and planning at all levels of government and industry

'Sound practice' in landslide risk management stems from coherent policies that are based on a comprehensive understanding of landslide risk which promotes preparedness mitigation and incorporates the participation of active agents in the community. It can only take place when it is integrated within government functions.

Formulate and amend legislation to support and promote landslide risk reduction

Although no laws, statutes or any other legal framework dealing specifically with slope management exist, elements supportive of and addressing the issues—albeit in an elementary form—can be found in some acts, regulations and guidelines existing in various sectors, such as in the land, environmental and building sectors.

The agency responsible for implementing slope management activities must have the necessary legal sanction and validity with requisite powers for managing slopes in the country. This is necessary to ensure that it is recognised by all stakeholders as the legitimate policy making and implementation authority. This shall be the long-term objective for the legal framework. In the meantime, since a great deal of work has to be undertaken in the drafting of appropriate laws which will support the actual implementation of the NSMP, CKC could rely on existing legislations to carry out almost all of its major tasks in the short term. There are also greater roles for professionally recognised geologists to play in promoting safer slopes. In the medium term, appropriate amendments to existing legislation shall be considered.

Build strong capabilities, expertise and networking in slope management

When setting up a national slope management system, it is important to emphasise that there is no single model that is appropriate for all countries and that institutional structures and legislation have to be designed by taking into account the specific circumstances, historical and cultural characteristics of the given country. At the same time, there are some general guidelines that should be followed to achieve the efficient functioning of a national slope management system. These principles include the existence of an explicit national slope strategy, integration of key players into the slope management process and provision of resources to key players to carry out their responsibilities.

Hazard and Risk Mapping Assessment

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000) Phase 1 2017 - 2018	WHEN/COST (RM '000) Phase 2 2019 - 2023	KPI BY END 2023
2.1	**Develop and update a national inventory of known landslides throughout the country**				
2.1.1	Plan and carry out data collection of known landslide-based on international practices	CKC, JMG, MRSA (MACRES)	10,000	10,000	Time-based historical record of known landslides
2.1.2	Prepare landslide inventory maps suitable for hazard and risk assessment	CKC, JMG, MRSA (MACRES)	500	500	Landslide inventory maps for risky areas as identified in the NSMP
2.2	**Develop standard guidelines for landslide hazard and risk mapping and assessment**				
2.2.1	Develop standard procedures for hazard and mapping and assessments	CKC, JMG	125	125	Landslide hazard and risk mapping standard
2.2.2	Develop standard procedures for qualitative and quantitative risk assessment	CKC, JMG	250	250	Qualitative/quantitative risk assessment procedure
2.3	**Develop a plan for mapping and assessing landslide hazard and risks**				
2.3.1	Mapping and prepare hazard and risk maps	CKC, JMG, MRSA (MACRES)	25,000	25,000	Hazard and risk maps of hotspot areas
2.3.2	Establish and carry out a standard approach for assessing landslide risks that will provide uniform information	CKC, JMG, MRSA (MACRES)	500	500	Landslide risk assessment procedures and report
2.3.3	Set the level of "acceptable risk" in slope management, including quantitative risk assessment	CKC, JMG, MRSA (MACRES)	1,200	3,000	Risk assessment line and social risk criteria for Malaysia
		SUBTOTAL	**37,575**	**39,375**	
		TOTAL	**76,950**		

Explanation of Strategies

Develop and update a national inventory of known landslides throughout the country

In this strategy, a temporal landslide inventory of known landslides is to be developed throughout the country. This inventory is the first step towards an accurate hazard and risk analysis tool. For the purpose of the NSMP study, a cursory look into the availability of hazard data was conducted. Historical records were collected from the local media, JMG and MACRES, and it was found that the information obtained was insufficient. Most of the data, especially those from the media, did not record important information critical for landslide inventory such as failure dimension and causal factors. A comprehensive data gathering initiative is needed to overcome this problem.

Develop standard guidelines for landslide hazard and risk mapping and assessment

In order to standardise the landslide hazard mapping and assessment process, a strategy needs be formulated. This will include a training program with a special developed training module and implement procedure for landslide hazard assessment including data collection.

Develop a plan for mapping and assessing landslide hazard and risks

In this strategy, a plan for nationwide landslide hazard and risk mapping and assessment exercise is to be developed. The locations of landslide-prone areas, where there are high probabilities of landslide occurrence with direct impact to life and property, are to be identified. Causal and triggering factor maps shall be collectively produced and assessed. Temporal data must be collected and managed. Elements at risk for landslides shall be mapped, stored and analysed. Thresholds for parameters that cause slope instability and landslide types and mechanisms are to be identified to categorise the slope hazard ratings. The vulnerability and consequences of landslides shall be identified for risk assessment during the implementation of this strategy.

With the hazard and risk classification developed, hazard and risk maps can be produced for areas identified in Strategy 2.1

Early Warning and Real-Time Monitoring Systems

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000) Phase 1 2017 - 2018	WHEN/COST (RM '000) Phase 2 2019 - 2023	KPI BY END 2023
3.1	**Setting up of national and regional EWS infrastructure**				
3.1.1	Develop Early Warning and Real Time Monitoring network structures based on landslide models	CKC,	5,000	0	Selecting and applying a suitable national model
3.1.2	Group each prioritised areas based on the risk maps landslide prone areas in terms of its common geological and rainfall patterns	CKC	5,000	0	Include the susceptibility, hazard, and risk maps in the forecasting model
3.1.3	Develop regional scale real time monitoring system	CKC	5,000	0	Increase the number of sensors
3.1.4	Develop site specific scale real time monitoring system	CKC	5,000	0	Increase the number of sensors
3.2	**Enhancement of JMM rainfall forecasting capacity**				
3.2.1	Upgrading and new installations of Doppler radar	JMM	10,000	40,000	Increase the Doppler radar footprint from 200 km to 300 km
3.2.2	Inclusion of the numerical weather predictor (NWP) in forecasting	JMM, CKC,	2,000	0	Include the NWP in the forecasting model to a two-day early warning
		SUBTOTAL	**32,000**	**40,000**	
		TOTAL	**72,000**		

Explanation of Strategies

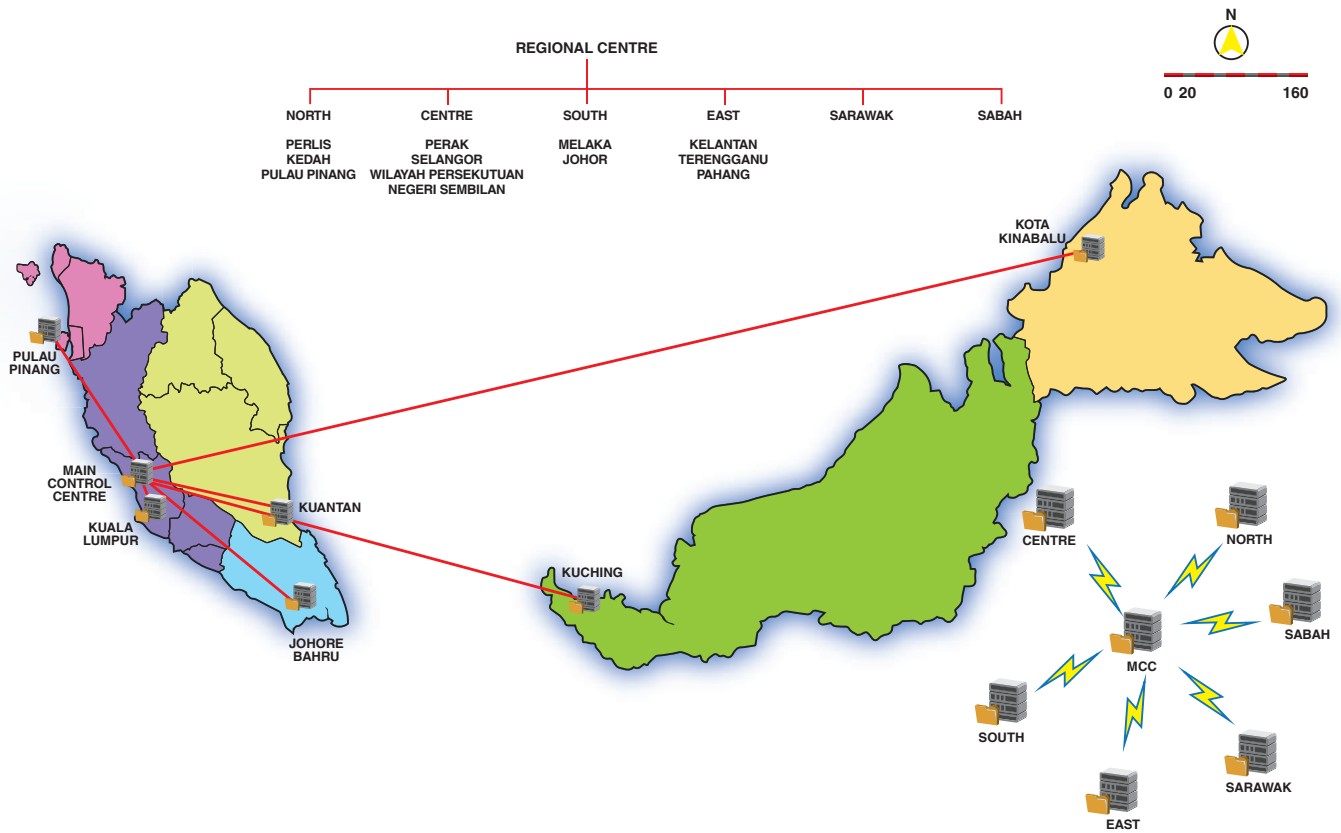
Setting up of national and regional EWS infrastructure

Because of the relatively large area of the country as well as differences in geological structure and weather patterns, there is a need to regionalise the early warning and real-time monitoring centres for easier system management.

Six regions are proposed to be set up to cater for landslide monitoring nationwide:

- North Region - covering Perlis, Kedah, Penang and Northern Perak
- Central Region - covering Southern Perak, Selangor, Wilayah Persekutuan, Negeri Sembilan
- Southern Region - covering Melaka and Johor
- Eastern Region - covering Kelantan, Terengganu and Pahang
- Sabah - covering Sabah
- Sarawak - covering Sarawak

To set up a national landslide early warning and real-time monitoring system, it is imperative that the national and regional organisational facilities be put in place first. This is so that the national and regional offices can safely host the multitude of infrastructure required, particularly the control centres, servers, computers, networking equipment and communication towers. Only then can the real-time monitoring network be created by linking site or regional sensors to the regional centres, and from there to the national control centre. This networking requires careful consideration of both hardware and software needs so that issues on compatibility, scalability, robustness and maintenance can be kept to a minimum.



The identification of regional and site-specific landslide prone areas falls under the realm of the component of hazard and risk mapping. However, the hazard and risk mapping exercise focuses predominantly on physical factors such as geological and geomorphological settings as well as economic factors such as the property value and lives lost. There is yet another factor that must be taken into consideration when undertaking the regionalisation exercise, which is common rainfall pattern. This data must be combined with physical and economic factors in order to identify truly common landslide-prone regions since regional prediction models will be based primarily on landslide-rainfall correlations.

Both regional and site-specific monitoring systems are proposed. Phase 1 will focus on site-specific monitoring, for which data collection and research and development are the main activities. At the outset, only regional monitoring—particularly in high-risk landslide prone areas in Wilayah Persekutuan, Kuala Lumpur, Penang, Sabah and the critical economic arteries of the North-South and the East Coast highways—is proposed. The specific areas are in the densely populated Ampang/Ulu Klang near Kuala Lumpur and in the Paya Terubung area in Penang. These locations will be the sites for the prototype landslide early warning and real-time monitoring systems.

Enhancement of JMM rainfall forecasting capacity

Although the present conventional radar is sufficient to provide weather forecasting information for the proposed early warning, real-time monitoring, and forecasting/nowcasting of landslides, it is imperative that JMM undertake the upgrading exercise of its conventional radars to Doppler radars as such state-of-the-art equipment is more conducive to the present needs, not only for landslide prediction, but for other disasters such as floods and other severe weather-related disasters.

New Action Plan: Inclusion of numerical weather predictor in forecasting

Malaysia Meteorology Department (MetMalaysia) transmits numerical weather predictor (NWP) data every 12 hours, generating 120 files. It represents the forecasted rainfall data for the next five days on an hourly basis. There are two types of files. One is for Peninsular Malaysia, and the other is for Sabah and Sarawak.

Loss Assessment

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000) Phase 1 2017 - 2018	WHEN/COST (RM '000) Phase 2 2019 - 2023	KPI BY END 2023
4.1	**Establish mandatory requirement for submission of landslide costs**				
4.1.1	Establish procedures for data compilation, integration and dissemination	CKC, local authorities	200	0	Establishment of procedure
4.1.2	Compile and analyse loss data	CKC, local authorities	500	1,000	Landslide loss report
4.1.3	Institute the requirements and purpose of landslide insurance coverage towards funding for insurance pool	CKC, local authorities	300	0	Insurance Policy Act
4.2	**Provide uniform guidelines for initial on-site damage assessment and relief expenses**				
4.2.1	Provide guidelines for assessing needs of victims and potential financial losses of affected area	CKC, local authorities emergency response agencies	350	0	Completed guideline
4.2.2	Conduct financial assessment by local authorities on the recovery of rescue and relief costs	CKC, legal agencies PIAM	500	1,000	Number of financial assessments made
4.4.3	Provide guidelines for recovery of rescue and relief costs	CKC, local authorities emergency response agencies	150	0	Completed guideline
		SUBTOTAL	**2,000**	**2,000**	
		TOTAL	**4,000**		

Explanation of Strategies

Establish mandatory requirement for submission of landslide costs

Serious efforts need to be instituted for commitment and consistency in compiling expenses and cost in all phases of landslide management. However, without a central policy on the requirement and the stated objectives for the integration of the loss data, public authorities and private interests will not be able to submit proper loss data as the exercise is viewed as entirely voluntary and additional efforts may not be supported.

The measures suggested for loss assessment frameworks at various phases of a landslide event will have tremendous implications on public policies. The insurance industry will play a major role in the risk sharing of losses in the events of landslides, especially where the socioeconomic impact on the community is large. The insurance schemes mentioned are in general terms and do not specify any specific instruments; the options are best provided by the insurance industries.

In the medium term, provisions for insurance companies to share the risks need to be drawn in the public policies for addressing the importance of mitigating measures. The type of insurance needs to be addressed by the government together with the insurance industry.

Provide uniform guidelines for initial on-site damage assessment and relief expenses

Assessment of damage and relief expenses shall be carried out immediately and efficiently, as well as documented for input into further mitigation, relief or rehabilitation and reconstruction plans. Uniform methods and guidelines for conducting initial on-site assessments of both damage and needs when landslides occur or are threatening to occur are critical tools for informed decision-making. Typically, on-site assessments would include establishing what resources are necessary to ensure the delivery of immediate, effective and appropriate response and relief measures to affected areas and communities and to facilitate business continuity.

The relevant government departments and local authorities shall undertake detailed assessment at their respective level for damages from landslide sustained in housing, commercial, industry, infrastructure, agriculture, health and education assets in the affected regions, using CKC frameworks and guidelines. In turn, these assessments shall be made available to facilitate the planning and implementation of the reconstruction and rehabilitation works.

Information Collection, Interpretation, Dissemination and Archiving

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000) Phase 1 2017 - 2018	WHEN/COST (RM '000) Phase 2 2019 - 2023	KPI BY END 2023
5.1	**Set up the system infrastructure of databases with slope catalogue and site investigation records**				
5.1.1	Establish the system infrastructure	CKC	2,000	0	Establishment of procedure
5.1.2	Establish the data quality management control	CKC	0	2,000	Include missing data strategies in the forecasting model
5.1.3	Set up the slope catalogue database, site investigation database of landslide events, and slope maintenance database	CKC	2,000	0	Integrate the database as a single unit
5.2	**Integration of JKR, JMM and JPS rain gauge stations**				
5.2.1	Automation of all rainfall data acquisition stations	CKC, JPS, JMM	5,000	0	Consolidate all rainfall stations under a single management
5.2.2	Networking of all rain gauge stations	CKC, JPS, JMM	1,000	1,000	Upgrade manual rainfall stations to telemetric
5.3	**Provide linkages among systems**				
5.3.1	Integrate the hazard and risk system, loss assessment model system and early warning systems	CKC, JMG	0	2,000	Integrate the applications as a single unit
5.4	**Extend the System for use during and after landslides for the emergency managers**				
5.4.1	Extend the System dissemination services through mobile devices on selected secure communication modes	CKC, NADMA, JPAM	0	25,000	Ensure information on demand for disaster managers
5.4.2	Extend the System for use at any emergency control centres	CKC, NADMA, JPAM	0	25,000	Ensure ease of free transfer of large spatial data for emergency control centres
5.5	**Improve the accuracy and timeliness of the information**				
5.5.1	Enhance existing modules for emergency managers, planners and designers	CKC, NADMA, JPAM	0	50,000	Develop specific applications to share data
		SUBTOTAL	**10,000**	**105,000**	
		TOTAL	**115,000**		

Explanation of Strategies

Set up the system infrastructure of databases with slope catalogue and site investigation records

This strategy calls for the setting up of the infrastructure for a slope information management system (the System) and building the slope catalogue and site investigation databases.

Initially, a system infrastructure comprising the appropriate hardware and essential software shall be designed and set up. The System shall accommodate the integration of future components to existing ones.

An important aspect of the System is the quality of its contents. This is to ensure that a large percentage of data entering the system is accurate. Controls are needed to manage the quality of data.

Integration of JKR, JMM and JPS rain gauge stations

The early warning and real-time monitoring system integration shall initially involve the three primary stakeholders, namely CKC, JMM and JPS. Highway concessionaires, particularly PLUS and MTD, who have their own early warning and real time monitoring systems need to be incorporated into the national system by virtue of their operating important economic arteries throughout the country.

JMM has about 240 stations throughout Peninsular Malaysia and about 70 stations in Sabah and Sarawak. The other major custodian of rain gauge stations in Malaysia is JPS. It operates about 834 manual rain gauge stations and 120 automatic rain gauge stations throughout Malaysia. All these rain gauge stations will have to be integrated into the national landslide early warning and real-time monitoring system.

Provide linkages among systems

The first component to be installed in the System is the centralisation of slope catalogue information into a database. All future information shall be linked to this catalogue, while historical information shall be reserved.

With the available slope catalogue database, other databases can be designed and linked. Existing site investigation records can be converted into a database that links to the slope catalogue. Once the database is completed, future site investigation records can be entered directly to the system. Site investigation reports can be generated automatically.

The slope maintenance database is a collection of maintenance records that are carried out and then stored in the slope catalogue database. Databases such as this can be linked to the other databases.

Extend the System for use during and after landslides for the emergency managers

This strategy extends the System for use during and after landslides for the emergency managers. At this phase, all slope information is available to the users of the System. However, the System can be extended to mobile devices for field users, for instance, in site investigation activities. This would allow the field users to access information pertaining to any particular slope.

Once the System is readily accessed at remote sites, the access can also be made available to any emergency control centres that are set up to monitor major landslide activities. The emergency control centres can access huge chunks of data that includes maps of entire areas. Whatever is available to the System users can be available to the emergency control centre operators.

Improve the accuracy and timeliness of the information

This strategy enhances the System to focus on the accuracy of simulated events and timeliness of information delivery.

At this phase, the System is information-centric, meaning that its role is solely limited to disseminating information to users. However, the System can be extended to perform analysis on the available information. For instance, the hazard ranking component can be extended to accommodate multiple ranking methodologies. The benefit to the users is that the System can analyse the different ranking results. This can applied to the other components such as the loss assessment system and the early warning system.

In addition to dissemination and analysis, CKC can develop a landslide simulation system from the information available in the System. From the loss assessment model, the simulation can determine the potential losses to the extended area derived from the slope catalogue. The Research and Development component is the driver for this activity.

Training

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000) Phase 1 2017 - 2018	WHEN/COST (RM '000) Phase 2 2019 - 2023	KPI BY END 2023
6.1	**Develop, coordinate and conduct training modules for relevant stakeholders**				
6.1.1	Develop and conduct technical training modules related to slope works	CKC, IEM, PAM, IGM, local authorities training institutes	2,442	6,105	Number of courses conducted
6.1.2	Develop and conduct administrative management training modules related to slope works	CKC, IKPKT, JPBD, local authorities training institutes	572	1,430	Number of courses conducted
6.1.3	Develop and conduct emergency response training modules related to slope failure emergency	CKC, local authorities, emergency responders	1,500	3,750	Number of courses conducted
6.2	**Develop specialised university courses and programs for slope engineering**				
6.2.1	Develop specialised university courses and programs for slope engineering		0	0	Number of courses conducted
		SUBTOTAL	**4,514**	**11,285**	
		TOTAL	**15,799**		

Explanation of Strategies

Develop, coordinate and conduct training modules for relevant stakeholders

This strategy is to develop and coordinate training programmes for practising engineers, specialists (engineering geologists, GIS scientists and meteorologists), architects, planners and decision-makers (local governments and agencies) as well as emergency response agencies with emphasis on technical, administration management and emergency response pertaining to slope engineering and management. Training in recognising potential slope failure and diagnosing pre- and post-failure conditions of slopes will also be carried out. Landslide hazard identification requires an understanding of the slope instability processes and the relationship of those processes to geomorphology, geology, hydrology, climate and vegetation.

In addition to the above, training on fundamental understanding of meteorology, rainfall forecasting, wind pattern, interpretation of satellite images, usage and application of geotechnical and meteorological instrumentation, troubleshooting equipment failures, understanding of early warning systems and appropriate response to warnings shall be conducted to enhance the capability and competency of the technical and professional personnel.

Training on data collection, compiling and interpreting databases or landslide inventories, storage, backing up and archiving databases will also be carried out regularly.

Develop specialised university courses and programs for slope engineering

The strategy is to develop training templates for undergraduate course notes and coordinate training curriculum for engineering undergraduates on planning, analysis, design, construction and maintenance of slopes.

However, academicians stated that the current curriculum is already too condensed and concentrated to accommodate any new additional material. Instead, a review of the basics of fundamental courses that could prepare students for further training on geotechnical engineering in the field could be carried out to determine what new material could be incorporated into the existing courses within the curriculum.

Public Awareness and Education

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000)		KPI
			Phase 1 2017 - 2018	Phase 2 2019 - 2023	BY END 2023
7.1	**Build and maintain public awareness capabilities of implementing agencies**				
7.1.1	Custodian agency to maintain the public communication function	CKC	0	0	Number of courses conducted
7.1.2	Produce marketing collateral for each target group (print and TVC)	CKC	600	1,500	Number of courses conducted
7.2	**Conduct public awareness programs based on user needs requirements**				
7.2.1	Develop appropriate methods and implement programs to the target groups for implementation by custodian and relevant external agencies (TVC, print, outreach)	CKC, relevant agencies	6,000	15,000	Number of courses conducted
7.2.2	Explore and deploy technologies and innovative methods for effective implementation of awareness and education initiatives and programs	CKC	500	1,250	Number of courses conducted
		SUBTOTAL	**7,100**	**17,750**	
		TOTAL	**24,580**		

Explanation of Strategies

Build and maintain public awareness capabilities of implementing agencies

In the 2009 NSMP, CKC was advised to set up a public communication function within the agency to communicate effectively with the public. This involves setting up a team for:

- graphic design and production
- multimedia production
- event management
- domain expert input and content development
- photograph management and archiving
- news production
- risk issues management
- target group liaison
- technical writing, editing, and illustration
- public relations

The function of the public communication department is to establish goodwill with the public, to create awareness of the target groups' respective roles and responsibilities in slope safety, and to disseminate educational material to deepen understanding.

CKC has set up such a function under the Corporate Unit back in 2010 and has been maintaining it since. It is recommended to continue doing so for the remainder of the NSMP period.

However, it has been noted that it is not enough to have CKC only in disseminating information about slope safety. The hazardous areas in the country are widespread, and CKC does not have the bandwidth to spread everywhere throughout the nation. Thus, CKC could provide source information and material to the local authorities and district offices that they could introduce to the communities through their own programs at the district level. An example of such an initiative is Majlis Perbandaran Ampang Jaya, which has developed awareness and education outreach programs based on CKC's content material and thus serves as an amplifier for CKC's efforts at the grassroots level.

Conduct public awareness programs based on user needs requirements

The ultimate purpose of public awareness and education programs is to encourage changes in behaviour within the target audience. This could be manifested as a change in practice, habit or mindset. Therefore it is important to create programs that are based on the target audiences' needs and requirements.

This means that information must be catered to suit the education level and needs of the target audience. Technical information regarding slope failure mechanisms, soil mechanics and geology must be simplified for comprehension by the target community groups. Other groups however may ask for more detailed explanations of the state of the slopes around their area. Different areas require different amount and level of information. For example, tips on the Malaysian Stormwater Manual (MSMA) practices on slopes may be relevant in urban settings but maybe not so in more rural areas. The nature of the community also determines how and what information should be provided—a farming community will be more interested in good practices for opening up for land for agricultural rather than a lecture on urban stormwater practices. In summary, create programs based on the endusers' needs.

Landslide Prevention Measures

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000)		KPI
			Phase 1	Phase 2	BY END 2023
			2017 - 2018	2019 - 2023	
8.1	**Start a landslide preventive measure program to address existing slopes**				
8.1.1	Conduct routine maintenance actions	CKC, JKR, KPKT, local authorities	400,000	1,000,000	Routine maintenance commented and continued
8.1.2	Prioritise and retrofit existing publicslopes	CKC, JKR, KPKT, JPBD, local authorities	400,000	1,000,000	Retrofitting of slopes commenced and continued
8.2	**Develop necessary framework and guidelines for best slope management and engineering practices**				
8.2.1	Set up working committees at federal and state levels	CKC, IEM, PAM, IGM, KPKT, JPBD, technical and local authorities	0	0	Working committees established
8.2.2	Develop and implement a detailed framework for best slope managementand engineering practices	CKC, IEM, PAM, IGM, KPKT, JPBD, technical and local authorities	0	0	Development of overall framework
8.2.3	Produce, review and update guidelines for planning, design, construction and maintenance	CKC, IEM, PAM, IGM, KPKT, JPBD, technical and local authorities	2,000	5,000	Number of guidelines produced
8.2.4	Create and maintain checklists to verify, planning, design, construction and maintenance	CKC, IEM, PAM, IGM, KPKT, JPBD, technical and local authorities	0	0	Number of checklists produced

8.2.5	Create and update guidelines for sustainable slope practices	CKC, IEM, PAM, IGM, KPKT, JPBD, technical and local authorities	0	1,300	Progress of guidelines preparation
8.3	**Incentivise practitioners to encourage best practices in slope management and engineering**				
8.3.1	Create and implement incentive schemes for developers, engineers and contractors	CKC, JKR, KKR, BEM, IEM, REHDA, CIDB	1,400	3,500	Awards given
8.3.2	Assess the viability of putting sustainable slope practices into actual use through pilot programs and create awareness for adoption by local practitioners and other players in the slope industry sector	CKC, IEM, BEM, ACEM, consultants, contractors	2,000	5,000	Pilot programs completed
8.4	**Develop a national platform to adopt landslide mitigation technology**				
	Encourage the set-up of a Special Interest Group (SIG) for sharing of latest landslide mitigation technologies among practitioners on the latest technologies	CKC, IEM, CIDB suppliers	1,200	1,000	Development of information sharing platform
		SUBTOTAL	**806,600**	**2,015,800**	
		TOTAL	**2,822,400**		

Explanation of Strategic Thrusts and Strategies

Change in name of component to better reflect its function and purpose

In this revision, the name of this component was changed from 'Loss Reduction Measures (LRM)' as mentioned in the previous NSMP to 'Landslide Prevention Measures (LPM)' to clarify its original purpose. The change was due to the fact that loss reduction measures, i.e. reduction of fatalities and economic losses, is the goal of the overall NSMP components and not just this component alone.

The description of this strategic thrust has also been revised. In the 2009 NSMP, the intention of this component was described as 'implementing a systematic approach to identify factors and hazards related to slope failures and select appropriate loss and landslide preventive measures'. However, as factors and hazards related to slope failures are already covered under Hazard Mapping and Assessment (HMA), the intention of this component has been revised to 'put in place guidelines for best practices in slope management and engineering, and initiate measures for landslide prevention'. This revised strategic thrust deals more with the physical works of slope engineering and management, i.e. planning, design, construction and maintenance.

Start a landslide preventive measure program to address existing slopes

Setting up the right framework and producing guidelines for best practices will only have an impact on new slopes, i.e. slopes that have yet to be built. Measures are also required to ensure that the old slopes, i.e. slopes that have been built without going through the proper guidelines, are also safe. There are 28,000 slopes that have been identified by JKR along the main federal routes, 19,470 of them in Peninsular Malaysia. Without maintenance management actions as recommended by the guidelines such as routine maintenance inspection and works, as well as engineer inspection for maintenance, these slopes will deteriorate and no longer be serviceable. The current maintenance contract under the road concessionaires only requires the clearing of drains. A five-year performance-based contract which includes inspection, investigation and rectification has been proposed for road concessionaires in Sabah. Similar maintenance contracts were proposed in 2010 for Peninsular Malaysia, but did not materialise. Local authorities and government agencies were also not able to conduct proper maintenance due to staffing and budgetary constraints.

Efforts are being made to classify slopes along the federal routes and landslide-prone areas according to levels of hazard under the HMA component. In order to minimise costs, the hazard rating could be used to determine the frequency of inspection. The engineer inspection under the maintenance actions could also be used to update the hazard or risk of the slopes.

Once the program of routine inspection is initiated and underway, retrofitting of risky slopes that pose serious danger to human lives and assets could be prioritised and undertaken.

Develop necessary framework and guidelines for best slope management and engineering practices

After the approval of the NSMP in 2009, at least nine guidelines relating to planning and design were issued by various agencies and at least three guidelines were updated. The guidelines issued by the Penang State Government and Dewan Bandaraya Kota Kinabalu even cover the submission requirements and some maintenance aspects.

The key issue raised by many stakeholders is the lack of coordination in preparing and reviewing these guidelines. Currently Penang, Selangor, Kuala Lumpur and most recently, Sabah have different rules and guidelines on hillside development, causing confusion and misunderstanding among the implementing agencies. There is an urgent need for guidelines to be coordinated or harmonised. The necessary policies and institutional framework also need to be established to support the preparation, maintenance and implementation of these guidelines.

Incentivise practitioners to encourage best practices in slope management and engineering

As CKC plays only an advisory role in the approval of development submissions, it is not possible for the branch to execute incentive and disincentive schemes for developers, contractors or consultants. The appropriate agencies to execute these schemes would be the local authorities, CIDB and BEM. According to the local authorities, such schemes are not required or practical. Only BEM could de-register a professional engineer. However, the board would only do so upon a court ruling, not based on complaints by a third party. After much discussion with the various stakeholders, it was concluded that a disincentive scheme is typically not workable; instead an incentive scheme would be more practical.

Develop a national platform to adopt landslide mitigation technology

The strategy was initially crafted to propose the set-up of a centralised slope information database and system, but this has been moved to the ICIDA component. The strategy has since been revised to reflect the need of practitioners and researchers to review and assess new technologies in slope engineering and management. There are many slope products and solutions in the market or are developed locally, but there is no platform to discuss in detail the technologies or methods among peers. Thus a special interest group to present and discuss on upcoming technologies is needed.

Emergency Preparedness, Response and Recovery

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000)		KPI
			Phase 1	Phase 2	BY END 2023
			2017 - 2018	2019 - 2023	
9.1	**Develop capacity for quality emergency response and recovery**				
9.1.1	Define and update clear policies, mechanisms and procedures	CKC, NADMA	0	0	Ratified by NADMA and disseminated to all emergency first responders
9.1.2	Identify and audit availability of deployable suitable equipment at landslide prone areas	CKC, district offices	3,050	600	Checklist developed and providers sourced
9.1.3	Conduct inter-agency drills among various emergency response agencies for landslides	CKC, NADMA, JPAM, emergency first responders	40	100	Achieved drill goals within target time
9.1.4	Shorten the days of preparation of preliminary report for disasters to less than three days	CKC	0	0	Less than three days
9.2	**Provide necessary geotechnical support, advice and forensic in landslide emergencies**				
9.2.1	Provide adequate and immediate support to emergency managers	CKC	0	0	Road and geotechnical services for search and rescue
9.2.2	Provide advisory and forensic services and help to bring the affected infrastructures into near normal operating conditions	CKC, NADMA, geotechnical engineers	0	0	Depends on budget required
		SUBTOTAL	**3,090**	**700**	
		TOTAL	**3,790**		

Explanation of Strategies

Develop capacity for quality emergency response and recovery

The rationale for this strategy that was stated in the 2009 Master Plan still applies. In a landslide emergency it is crucial that response be on site within an hour after notification if lives or property in danger are to be saved. This requires emergency response deployment of all stakeholders to be on time to give effective response to meet this threat to lives and property. To ensure that this comes to pass, clear policies and procedures must be well laid out, well-coordinated and followed by all as there is no time in an emergency

to dither or to debate over who is to do what and how to do them. The requirement of on-site response within an hour has become a key performance indicator for JKR, which to date, CKC has always fulfilled.

The 2009 NSMP called for nationwide policies and mechanisms for landslide to be documented and a SOP to be jointly prepared by all agencies involved in landslide disasters. In 2016, the SOP has been drafted and submitted to NADMA for approval and distribution.

Other than a SOP for landslides at the national level, a more detailed SOP at the CKC departmental level will also need to be prepared. This SOP will cover not only the detailed procedures that need to be adhered to by CKC during landslide disasters, but also during all stages of landslide emergencies. This departmental SOP should be cross-referenced to the nationwide SOP and will need to be submitted to MKN for approval, as required under MKN 20.

All national, state and local agencies identified as key role players in landslide disaster management are required to prepare their own SOPs which cover landslide disasters. However, it should be recognised that there is considerable unevenness in landslide disaster management planning capacity and experience, hence a need to undertake careful consultation with relevant stakeholders before developing these SOPs.

To achieve integration across all levels, CKC must be given the task to guide the development of SOPs on landslides to ensure coherence, uniformity, and alignment to MKN 20 and the nationwide landslide SOP. It must also consult with the ICSM.

For timely response to landslide emergencies, stakeholders should purchase suitable equipment, such as search equipment and heavy machineries in sufficient numbers and situate them in locations based on hazard or risk maps that are disseminated by CKC. As for CKC, equipment that enable their geotechnical engineers to determine the extent, speed and direction of the landslide must be purchased.

Examples of such equipment are:

- Three Dimensional Terrestrial Laser Scanner
- Ground Penetrating Radar
- In-Place Inclinometer
- AirRobot - Radio controlled helicopter for aerial reconnaissance

These equipment and trained technicians are to be situated at the regional centres, that will be set up in or near high-risk landslide areas, to ensure that these equipment and personnel can reach the landslide site on time; and in concert with the geotechnical engineers. It is also crucial to ensure these equipment are in operational readiness at all times.

Inter-agency drills incorporating real-life scenarios are necessary to raise the level of response in landslide emergencies. This has been proven to be the case in various countries. Almost all emergency response agencies in Malaysia have also highlighted the need for regular inter-agency drills. Only periodic drills can reveal the flaws and the inadequacies in a coordinated response and recovery, so that policies or mechanisms can be improved without having to learn from an actual landslide emergency.

ICSM could be used as the vehicle to formulate a mutual cooperation agreement between various stakeholders in landslide emergencies. With assistance from other agencies and the directive and approval from MKN, CKC could conduct mutual inter-agency drills for landslides.

Provide necessary geotechnical support, advice and forensic in landslide emergencies

Support through information management and technical assistance at the scene of a disaster will enhance the search and rescue operations. The issue of safety during the search and rescue operation is crucial as lives of rescuers can be jeopardised. In order to minimise the risks of exposing the rescuers to dangerous situations, CKC shall look forward to mobilise an emergency landslide response team to provide on-site assistance or technical advice to the various rescue agencies.

In most cases, the first question of the rescuers is the location of the buried victims. A landslide response team from CKC can play an important role by sharing their knowledge with the rescuers in locating the buried victims. This is primarily due to the fact that an understanding of the landslide mechanism can lead to a better judgment for pinpointing the location of a buried victim. Each landslide is unique and therefore, the team member has to use his/her own judgment to maximise the victim's chances of survival within the limitations of available resources.

Other than providing support to search and rescue agencies locally, the CKC emergency response team should also be deployed to assist in landslide disasters overseas so that useful experience could be gained from abroad.

Research and Development

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000) Phase 1 2017 - 2018	Phase 2 2019 - 2023	KPI BY END 2023
10.1	**Encourage joint research programs on landslides with established research organizations**				
10.1.1 10.1.2	Develop methodology for data modelling and analysis for economic assessment Conduct integrated research on landslide numerical simulation	Universities, Research Institutes, Private Companies	500	2,500	Establishment of a methodology adopted by JKR
	system showing the extent of damage to lives and property of potential landslides	Universities, Research Institutes, Private Companies	0	25,000	Development of a landslide numerical simulation system adopted by JKR
10.1.3	Develop and implement a national research agenda for slopes for fundamental and applied research	CKC, JKR, ICSM, universities	2,000	5,000	Set up of a research framework and formulate an agenda
10.1.4	Set up a research network for periodic reviews and journals, practitioner feedback and peer evaluation	ICSM, CKC, JKR, universities	100	500	Set up of a multi-sectoral research network and establish a feedback system tand review mechanism
10.2	**Collaborate with funding agencies to give priority to slope research**				
10.2.1	Coordinate with funding agencies to fund research identified in the national agenda	CKC, JKR, ICSM, MOHE JICA, MOSTI, KeTTHA, NRE	0	0	Set up of an R&D working committee Set up of a funding policy and mechanism
		SUBTOTAL	**2,600**	**33,000**	
		TOTAL	**35,600**		

Explanation of Strategies

Encourage joint research programs on landslides with established research organisations

This strategy is based on the comments and inputs from the workshop sessions with researchers and academicians. Other component researchers suggested specific topics for research such as loss assessment for economic assessment and numerical simulation for assessing potential losses in lives and properties. At the same time, engagement with the research institutions for fundamental and applied research was highlighted. This should be started with the process of JKR creating a national agenda for research topics to be carried out over the next two phases of the NSMP.

Collaborate with funding agencies to give priority to slope research

One of the difficulties among the research institutions within the country's academia was the oversupply and redundancies in certain research areas such as hazard mapping, which also overlapped with government mapping initiatives. Research topics were also not aligned with JKR goals and needs, thus making it difficult for wider adoption of research results within JKR. Funding sources for research have been varied and includes the Ministry of Higher Education (MOHE), the Ministry of Science, Technology and Innovation (MOSTI), international funding agencies and donors such as the Japan International Cooperation Agency (JICA), the European Commission, and the EU Framework Programme for Research and Innovation.

Sustainable Slope Practices (SSP)

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000)		KPI
			Phase 1	Phase 2	BY END 2023
			2017 - 2018	2019 - 2023	
11.1	**Research and explore sustainable practices for slopes**				
11.1.1	Research and explore new and innovative approaches to sustainable slopes	Universities, Research Institutes, Private Companies	1,400	3,500	Guidelines on sustainable slope practices
		SUBTOTAL	**1,400**	**3,500**	
		TOTAL	**4,900**		

Explanation of Strategies

Research and explore sustainable practices for slopes

Sustainability of slopes is more than the planting of vegetation on slopes or green construction; it involves the consideration of slopes having environmental, socio-cultural and economic as well as environmental value. This perspective allow slopes to be looked at as an asset that could provide significant value to society, rather than a geological feature that requires high maintenance and is a source of high cost in public funds. Slopes for protection of wildlife habitat, heritage conservation, revenue generator as ad space as well as source of eco-engineering and vegetation practices will be researched in this area. Research and exploration of sustainable practices can result in the prevention and mitigation of unstable slopes to be carried out in a more sustainable way. In addition, best practices and guidelines are necessary for landscape treatment of man-made slopes, and engineering works on natural terrain should be carried out to support sustainable slope landscapes in Malaysia.

The discipline of sustainability and slopes is nascent in Malaysia, but shall be explored further among the researcher and practitioner communities in the country.

STRATEGIES BY THRUST

- STRATEGIES BY THRUST
- IMPLEMENTATION SCHEDULE, COSTS AND KPIs BY THRUSTS
- THRUSTS

STRATEGIES BY THRUSTS

In the previous section, NSMP strategies have been presented by components. However, for ease of implementation, the strategies are re-organised here by thrusts, making it easier for stakeholders to carry out the strategies.

11 COMPONENT THRUSTS FOR EASY MANAGEMENT

COMPONENT	STRATEGIC THRUST
Policies and Institutional framework (PIF)	Develop effective policy and institutional frameworks for landslide risk reduction, mitigation and disaster preparedness
Hazard Mapping and Assessment (HMA)	Develop a framework to establish an inventory of susceptible areas and different types of landslide hazard/risk mapping and assessment at a scale useful for planning and decision making.
Early Warning and Real-Time Monitoring System (EWS)	Conduct ongoing monitoring and provide warning on slope hazards to relevant authorities to initate timely preventive measures and reduce the damage caused by landslides.
Loss Assessment (LA)	Compile, maintain and eveluate information on the various types of losses resulting from landslides to guide mitigation activities and track progress in reducing losses.

Condensed to

5 PRIORITY AREAS/THRUSTS FOR IMPLEMENTATION AND COMMUNICATION PURPOSES

Implementation Schedule, Costs and KPIs by Thrust

The following tables show the phased implementation of the strategies, action plans, budgets, and KPIs by thrusts.

As explained earlier, while it is easier to view implementation as discrete components, in practice, implementation is carried out as a series of activities centred around a main objective, such as the assessment of landslide risks. Because of dependencies and the interconnected nature of activities, several components are needed to achieve one objective—hence, the presentation of strategies as thrusts.

Also, to communicate the objective of the strategies to stakeholders, it is easier to view them as a cluster of themes rather than individual components.

Thrust 1: Assessing Landslide Risks

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000) Phase 1 2017 - 2018	WHEN/COST (RM '000) Phase 2 2019 - 2023	KPI BY END 2023
1.1	**Develop and update a national inventory of known landslides throughout the country**				
1.1.1	Plan and carry out data collection of known landslide-based on international practices(HMA)	CKC, JMG, MSRA (MACRES)	10,000	10,000	Time-based historical record of known landslides
1.1.2	Prepare landslide inventory maps suitable for hazard and risk assessment (HMA)	CKC, JMG, MSRA (MACRES)	500	500	Landslide inventory maps for risky areas as identified in the NSMP
1.2	**Develop standard guidelines for landslide hazard and risk mapping and assessment**				
1.2.1	Develop standard procedures for hazard and risk mapping and assessment (HMA)	CKC, JMG	125	125	Landslide hazard and risk mapping standard
1.2.2	Develop standard procedures for qualitative and quantitative risk assessment (HMA)	CKC, JMG	250	250	Qualitative/ quantitative risk assessment procedure
1.3	**Develop a plan for mapping and assessing landslide hazard and risks**				
1.3.1	Mapping and preparing hazard and risk maps (HMA)	CKC, JMG, MSRA (MACRES)	25,000	25,000	Hazard and risk maps of hotspot areas
1.3.2	Establish and carry out a standard approach for assessing landslide risks that will provide uniform information (HMA)	CKC, JMG, MSRA (MACRES)	500	500	Landslide risk assessment procedures and report
1.3.3	Set the level of "acceptable risk" in slope management, including quantitative risk assessment (HMA)	CKC	1,200	3,000	Risk assessment line and social risk criteria for Malaysia
		SUBTOTAL	**37,575**	**39,375**	
		TOTAL	**76,950**		

Thrust 2: Investing in Risk Reduction

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000)		KPI
			Phase 1	Phase 2	BY END 2023
			2017 - 2018	2019 - 2023	
2.1	**Setting up of national and regional EWS infrastructure**				
2.1.1	Develop Early Warning and Real Time Monitoring network structures based on landslide models (EWS)	CKC	5,000	0	Selecting and applying a suitable national model
2.1.2	Group each prioritised area based on the risk maps of landslide prone areas in terms of its common geological and rainfall patterns (EWS)	CKC	5,000	0	Include the susceptibility, hazard and risk maps in the forecasting model
2.1.3	Develop regional scale real time monitoring system (EWS)	CKC	5,000	0	Increase the number of sensors
2.1.4	Develop site specific scale real time monitoring system (EWS)	CKC	5,000	0	Increase the number of sensors
2.2	**Integration of JKR, JMM and JPS rain gauge stations**				
2.2.1	Automation of all rainfall data acquisition stations (ICIDA)	CKC, JPS, JMM	5,000	0	Consolidate all rainfall stations under a single management
2.2.2	Networking of all rain gauge stations (ICIDA)	CKC, JPS, JMM	1,000	1,000	Upgrade manual rainfall to telemetric
2.3	**Enhancement of JMM rainfall forecasting capacity**				
2.3.1	Upgrading and new installations of Doppler Radar (EWS)	JMM	10,000	40,000	Increase the Doppler radar footprint from 200 km to 300 km
2.3.2	Inclusion of the numerical weather predictor (NWP) in forecasting (EWS)	JMM, CKC	2,000	0	Include the NWP in the forecasting model to a two day early warning
2.4	**Set up the system infrastructure of databases with slope catalogue and site investigation records**				
2.4.1	Establish the system infrastructure (ICIDA)	CKC	2,000	0	Set up a complete system framework
2.4.2	Establish the data quality management control (ICIDA)	CKC	0	2,000	Include missing data strategies in the forecasting model
2.4.3	Set up the slope catalogue database, site investigation database of landslide events, and slope maintenance database (ICIDA)	CKC	2,000	0	Integrate the database as a single unit

Thrust 2: Investing in Risk Reduction *(continued)*

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000)		KPI
			Phase 1	Phase 2	BY END 2023
			2017 - 2018	2019 - 2023	
2.5	**Provide linkages among systems**				
2.5.1	Integrate the hazard and risk system, loss assessment model system and early warning systems (ICIDA)	CKC, JMG	0	2,000	Integrate the applications as a single unit
2.6	**Build and maintain public awareness capabilities of implementing agencies**				
2.6.1	Custodian agency to maintain the public communication function (PAE)	CKC	0	0	Yearly operational budget and activities
2.6.2	Produce marketing collateral for each target group (PAE)	CKC	600	1,500	Yearly production of collateral
2.7	**Conduct public awareness programs based on user needs requirements**				
2.7.1	Develop appropriate methods and implement programs to the target groups for implementation by custodian and relevant external agencies (PAE)	CKC, relevant agencies	6,000	15,000	CKC: One major campaign/program per year
2.7.2	Explore and deploy technologies and innovative methods for effective implementation of awareness and education initiatives and programs (PAE)	CKC	500	1,250	CKC to provide collateral material to local government agencies. One major campaign per year.
2.8	**Start a landslide preventive measure program to address existing slopes**				
2.8.1	Conduct routine maintenance actions (LPM)	CKC, JKR, KPKT, JPBD, local authorities	400,000	1,000,000	Routine maintenance commenced and continued
	Prioritise and retrofit existing man-made and natural slopes (LPM)		400,000	1,000,000	Retrofitting of slopes commenced and continued
		SUBTOTAL	**849,100**	**2,062,750**	
		TOTAL	**2,911,850**		

Thrust 3: Promoting Good Governance

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000) Phase 1 2017 - 2018	WHEN/COST (RM '000) Phase 2 2019 - 2023	KPI BY END 2023
3.1	**Operationalise multi-sectoral and integrated slope management mechanisms**				
3.1.1	Establish and maintain coordinating committees on slope management at the national, state and local authority levels (PIF).	CKC	0	0	Operate at national state and local level.
3.1.2	Identify funding sources and provide budgetary allocation for slope and disaster management (PIF).	CKC, MOHE	0	0	Framework for funding mechanism. Set up national fund.
3.1.3	Explore and adopt innovative methods of sharing and transferring the costs associated with landslide risk reduction and disasters to alleviate the burden on the state (PIF).	PIAM	5,000	6,250	Appoint consultant to advise on identifying and creating funding mechanism. Mandatory landslide protection.
3.1.4	Set up a network of government departments, local authorities, disaster management agencies, research institutions, disaster management specialists, NGOs, community groups, and other stakeholders to augment their capabilities and encourage best practices (PIF).	CKC, ICSM, JKR	0	0	JKR as technical reference centre.
3.1.5	Cooperate with international agencies for the sharing and dissemination of knowledge in slope and disaster management and for assistance of expertise and resources in slope and disaster management (PIF)	JKR, CKC, all other stakeholders	0	0	JKR as the manager of NSMP.
3.2	**Integrate landslide risk assessment and risk reduction planning into development policies and planning at all levels of government and industry**				
3.2.1	Ensure that the planning activities of federal, state and local authorities take into account slope protection and landslide risk reduction (PIF)	KPKT, TCPD, CKC, JMG	0	0	All local authorities and states within landslide sensitive areas to have and implement guidelines on slope management or slope management plans and to have engineering units

Thrust 3: Promoting Good Governance *(continued)*

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000) Phase 1 2017 - 2018	WHEN/COST (RM '000) Phase 2 2019 - 2023	KPI BY END 2023
3.3	**Formulate and amend legislation to support and promote landslide risk reduction**				
3.3.1	Formulate/modify appropriate legislation and guidelines for better slope and landslide disaster management and to improve the professionalism of geologists, especially in the assessment of slope hazards (PIF)	Slope management: JKR, KPKT, TCPD, LA, DOE, IEM, JMG	0	5,000	Formulate national policy on slope management/ development on slopes. Formulate new law on slope management. Key legislation to be amended to include regulations on slope management.
3.4	**Build strong capabilities, expertise and networking in slope management**				
3.4.1	Strengthen CKC to become a Slope Engineering Agency including strategic regional centres, with adequate support, capabilities, expertise and power in developing and streamlining slope management activities (PIF)	CKC, JKR	0	0	CKC to be the managers of the NSMP.
3.5	**Establish mandatory requirement for submission of landslide costs**				
3.5.1	Establish procedures for data compilation, integration and dissemination (LA)	CKC, local authorities	200	0	Establishment of procedure
3.5.2	Compile and analyse loss data (LA)	CKC, local authorities	500	1,000	Landslide loss report
3.5.3	Institute the requirements and purpose of landslide insurance coverage towards funding for insurance pool (LA)		300	0	Insurance Policy Act
3.6	**Provide uniform guidelines for initial on-site damage assessment and relief expenses**				
3.6.1	Provide guidelines for assessing needs of victims and potential financial losses of affected area (LA)	CKC, local authorities emergency response agencies	350	0	Completed guideline
3.6.2	Conduct financial assessment by local authorities on the recovery of rescue and relief costs (LA)	CKC, legal agencies PIAM	500	1,000	Number of financial assessments made

Thrust 3: Promoting Good Governance *(continued)*

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000)		KPI
			Phase 1	Phase 2	BY END 2023
			2017 - 2018	2019 - 2023	
3.6.3	Provide guidelines for recovery of rescue and relief costs (LA)	CKC, local authorities emergency response agencies	150	0	Completed guideline
3.7	**Develop, coordinate and conduct training modules for relevant stakeholders**				
3.7.1	Develop and conduct technical training modules related to slope works (TRN)	CKC, IEM, PAM, IGM, local authorities training institutes	2,442	6,105	Number of courses conducted
3.7.2	Develop and conduct administrative management training modules related to slope works (TRN)	CKC, IKPKT, JPBD, local authorities training institutes	572	1,430	Number of courses conducted
3.7.3	Develop and conduct emergency response training modules related to slope failure emergency (TRN)	CKC, local authorities emergency responders	1,500	3,750	Number of courses conducted
3.8	**Develop specialised university courses and programs for slope engineering**				
3.8.1	Develop specialised university courses and programs for slope engineering (TRN)	CKC, MOHE universities	0	0	Number of courses conducted
3.9	**Develop necessary framework and guidelines for best slope management and engineering practices**				
3.9.1	Set up a working committee at federal and state levels (LPM)	CKC, IEM, PAM, IGM, KPKT, JPBD, technical and local authorities	0	0	Working committees established
3.9.2	Develop and implement a detailed framework for best slope management practices (LPM)	CKC, IEM, PAM, IGM, KPKT, JPBD, technical and local authorities	0	0	Development of overall framework
3.9.3	Produce, review and update guidelines for planning, design, construction and maintenance (LPM)	CKC, IEM, PAM, IGM, KPKT, JPBD, technical and local authorities	2,000	5,000	Number of guidelines produced
3.9.4	Create and maintain checklists to verifyfor verification, planning, design, construction and maintenance (LPM)	CKC, IEM, PAM, IGM, KPKT, JPBD, technical and local authorities	0	0	Number of checklists produced

Thrust 3: Promoting Good Governance *(continued)*

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000)		KPI
			Phase 1	Phase 2	BY END 2023
			2017 - 2018	2019 - 2023	
3.9.5	Create and update guidelines for sustainable slope practices (LPM)	CKC, IEM, PAM, IGM, KPKT, JPBD, technical and local authorities	0	1,300	Progress of guidelines preparation
3.10	**Incentivise practitioners to encourage best practices in slope management and engineering**				
3.10.1	Create and implement incentive schemes for developers, engineers and contractors (LPM)	CKC, JKR, KKR, BEM, IEM, REHDA, CIDB	1,400	3,500	Awards given
3.10.1	Assess the viability of putting sustainable slope practices into actual use through pilot programs and create awareness for adoption by local practitioners and other players in the slope industry sector (LPM)	CKC, IEM, BEM, ACEM, consultants, contractors	2,000	5,000	Pilot programs completed
3.11	**Develop a national plan to adopt landslide mitigation technology**				
3.11.1	Encourage the set-up of a Special Interest Group (SIG) for sharing of latest landslide mitigation technologies among practitioners on the latest technologies (LPM)	CKC, IEM, CIDB suppliers	1,200	1,000	Development of information sharing platform
		SUBTOTAL	**18,114**	**40,335**	
		TOTAL	**58,449**		

Thrust 4: Preparing for Response and Recovery

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000) Phase 1 2017 - 2018	WHEN/COST (RM '000) Phase 2 2019 - 2023	KPI BY END 2023
4.1	**Extend the System for use during and after landslides for the emergency managers**				
4.1.1	Extend the System dissemination services through mobile devices on selected secure communication modes (ICIDA)	CKC, NADMA, JPAM	0	25,000	Ensure information on demand for disaster managers
4.1.2	Extend the System for use at any emergency control centres(ICIDA)	CKC, NADMA, JPAM	0	25,000	Ensure ease of free transfer of large spatial data for emergency control centres
4.2	**Improve the accuracy and timeliness of the information**				
4.2.1	Enhance existing modules for emergency managers, planners and designers (ICIDA)	CKC, NADMA, JPAM	0	50,000	Develop specific applications to share data
4.3	**Develop capacity for quality emergency response and recovery**				
4.3.1	Define and update clear policies, mechanisms and procedures (EPRR)	CKC, NADMA	0	0	Ratified by NADMA and disseminated to all emergency first responders
4.3.2	Identify and audit availability of deployable suitable equipment at landslide prone areas (EPRR)	CKC, district offices	3,050	600	Checklist developed and providers sourced
4.3.3	Conduct inter-agency drills among various emergency response agencies for landslides (EPRR)	CKC, NADMA, JPAM, emergency first responders	40	100	Achieved drill goals within target time
4.3.4	Shorten the days of preparation of preliminary report for disasters to less than three days (EPRR)	CKC	0	0	Less than three days
4.4	**Provide necessary geotechnical support, advice and forensic in landslide emergencies**				
4.4.1	Provide adequate and immediate support to emergency managers (EPRR)	CKC	0	0	Road and geo technical services for search and rescue
4.4.2	Provide advisory and forensic services and help to bring the affected infrastructures into near normal operating conditions (EPRR)	CKC, NADMA, geotechnical engineers	0	0	Depends on budget required
		SUBTOTAL	**3,090**	**100,700**	
		TOTAL	**103,790**		

Thrust 5: Spurring Innovation

NO.	ACTION PLAN	WHO	WHEN/COST (RM '000) Phase 1 2017 - 2018	WHEN/COST (RM '000) Phase 2 2019 - 2023	KPI BY END 2023
5.1	**Encourage joint research programs on landslides with established research organisations**				
5.1.1	Develop methodology for data modelling and analysis for socioeconomic assessment (R&D)	Universities, private companies	500	2,500	Establishment of a methodology adopted by JKR
5.1.2	Conduct research on landslide numerical simulation system showing the extent of damage to lives and property of potential landslides (R&D)	Universities, private companies	0	25,000	Development of a landslide numerical simulation system adopted by JKR
5.1.3	Research and explore new and innovative approaches to sustainable slopes (SSP)	Universities, private companies	1,400	3,500	Input towards guidelines on sustainable slope practices
5.1.4	Develop and implement a national research agenda for slopes for fundamental and applied research (R&D)	CKC, JKR, ICSM	2,000	5,000	Set up of a research framework and carry through
5.1.5	Set up a research network for periodic reviews and journals, practitioner feedback and peer evaluation (R&D)	ICSM, CKC, JKR	100	500	Establishment of a multi-sectoral research network and set up of a feedback system and review mechanism
5.2	**Collaborate with funding agencies to give priority to slope research**				
5.2.1	Coordinate with funding agencies to fund research identified in the national agenda (R&D)	CKC, JKR, ICSM, MOHE JICA, MOSTI, KeTTHA, NRE	0	0	Set up of a R&D working committee. Set up of a funding policy and mechanism
	SUBTOTAL		**4,000**	**36,500**	
	TOTAL		**40,500**		

IMPLEMENTATION STRUCTURE

- DELIVERY AND IMPLEMENTATION MECHANISM
- ADVANTAGES OF A WORKING COMMITTEE STRUCTURE
- OTHER DELIVERY METHODS

IMPLEMENTATION **STRUCTURE**

As mentioned in the previous chapter, CKC noted that many external stakeholders encountered various issues when addressing slope management matters. These issues ranged from questions over which agency had the final authority in situations that called for decision-making, how to resolve the issue of redundant or similar guidelines to adopt into their own strategy planning, not knowing how to share data with CKC in the absence of a clear proforma, and what standard, protocol or format to use to share information with CKC. Additionally, it was also discovered that several agencies had carried out relevant slope action plans, but they did not adhere or conform to the objectives of the NSMP due to lack of awareness of the Master Plan.

DELIVERY AND IMPLEMENTATION MECHANISM

In consideration of the above issues and the manpower limitations that CKC faced, it soon became evident that the best way to implement the strategies was through the mechanism of a working committee consisting of not only CKC, but relevant agencies and organisations whose functions encompass matters involving slopes and landslides.

The elements of an NSMP delivery and implementation mechanism are the formation of (1) working committees for each NSMP thrust or priority area, (2) a special function within ICSM for managing and monitoring the working committees, and (3) a reporting structure for communicating the NSMP progress initiatives to the departmental, ministerial, and Cabinet level. This also calls for a dedicated unit within CKC for managing and monitoring the working committees.

Structural framework of NSMP action plan implementation

1 - Formation of NSMP Working Committees

Working committees for each priority area is proposed to carry out the action plans of the NSMP. Each working committee is headed by a senior government officer of a relevant agency, an industry practitioner, captain of the industry, or equivalent. The role of the working committee is to implement strategies and action plans under their priority area. The secretariat of each working committee is a CKC manager. A working committee model is expected to encourage collaboration, linkages and sharing of knowledge and experience among the members, as opposed to implementation by a single agency such as CKC where it is easy to fall into the 'silo' approach to strategy execution.

2 - ICSM as a Steering Committee

ICSM is a multi-party consortium of government agencies from various disciplines such as housing, local government, disaster management, law and order, search and rescue, public health, meteorology, and river management. It was formed five years ago after the release of the NSMP, and meets once or twice a year. The establishment of the Committee is one of the action plans in the NSMP that has been successfully implemented. The director of CKC is the chairman of the Committee, and the committee members are the various government agencies who joined on an invitation basis. There are currently 25 agencies in the ICSM.

The current function of the ICSM is predominantly for information sharing among the stakeholders regarding slope matters. However, its scope can be expanded to include the overseeing of NSMP action plans, where problem-solving, issues resolution, and communication to each respective agency can take place.

3 - Creation of Reporting Channel to JKR, KKR and Cabinet

Lastly, another necessary element of the NSMP delivery system is a channel to report significant achievements and attainment of NSMP goals to the Public Works Department, Ministry of Works, and the Cabinet. This is not only for reporting purposes, but to make the ministers and upper management aware of CKC achievements that can be disseminated to other stakeholders, including members of the public.

For the three tiers of the implementation structure to work, there must be one more institutional set-up to be made, that is the formation of a dedicated NSMP unit within CKC.

Formation of an NSMP Unit Within CKC for Implementation and Monitoring

Internally, within CKC there must be a dedicated unit for the implementation and monitoring of the action plans. Currently, this function rests with the *Bahagian Transformasi Teknologi Cerun;* however, it is managed by a single staffer who has other non-NSMP related job responsibilities. As there are 11 components to manage under the revised NSMP, more staff will need to be allocated for the management of the working committee activities and progress. Thus, the recommendation is to either establish one unit dedicated to NSMP management or create a management committee comprising the heads of the CKC units.

Structure of CKC management to working committees

ADVANTAGES OF A WORKING COMMITTEE STRUCTURE

The working committee structure seems to be the best model for CKC as it addresses many of the issues highlighted by CKC.

Advantages of a working committee

The pros of the working committee model are that it allows CKC to delegate the work of implementing the action plans to agencies and organisations on issues of common ground and where linkages are crucial. It keeps stakeholders engaged and allows continuity of communication even after the officer in charge has transferred out of his or her department. It also allows CKC to retain its role as manager while delegating the bulk of the work to motivated stakeholders. If a thrust has many tasks and activities to be carried out, sub-committees can be formed.

The cons are that after a while of being on the committee, attrition or 'dropping out' may occur, resulting in abandonment of action plan implementation or agencies in charge may deviate from the original objective of the NSMP strategy to follow its own departmental agenda. However, with proper controls and incentives, these drawbacks can be overridden.

Overall, the advantages of a working committee structure outweighs the negatives, and thus it is recommended to improve the delivery of the NSMP contents. However, it is important to bear in mind that the above are basic guidelines for implementation, and that further detailed discussion among CKC managers is needed to come up with a framework that best suits their working culture and organisation.

OTHER DELIVERY METHODS

In addition to the framework described above, other delivery improvement methods as suggested by the stakeholders at the workshops include roadshows, brochures, posters, seminars, print and broadcast media, and other conventional awareness methods. Methods should also include social media approaches. Promotion methods for the NSMP can be discussed in further detail at the working committee level.

In addition to the channels used to deliver the NSMP content, attention must be given to the messaging of the NSMP 'package' to widen the potential of benefits that the NSMP has to offer to its target groups.

Key Messages

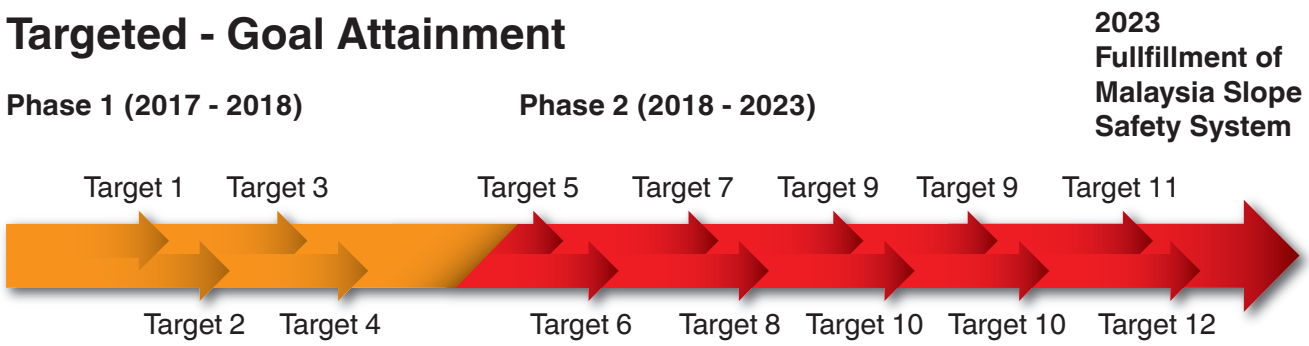
One of the key messages to convey regarding the NSMP and slope management is that slope management should not be confined to the realm of disasters only. Slope management and landslides have long been regarded and promoted as a natural or manmade disaster, but such events are far rarer than chronic but minor landslides or landslips in urban areas. Concerns over public and personal safety among residents in hillside neighbourhoods or near slope developments make this issue a matter of wellbeing (safer cities and neighbourhoods). In this way, the definition of slope failures and landslides can be broadened beyond the confines of 'disaster'. Peace of mind, quality of life, and a sense of safety in one's home are also indices of wellbeing, a target listed in the Eleventh Malaysia Plan. This and other linkages to national and international agendas and strategic plans should be considered when proposing budgets and projects for NSMP implementation.

THE SLOPE INDUSTRY IN 2023

WHAT DOES IT LOOK LIKE?

YEAR - BY - YEAR
IMPLEMENTATION OF NSMP ACTIONS

To make it easier for the CKC managers of the NSMP, a year-by-year implementation of the action plans is provided in this Master Plan revision. This shall make it easier for the CKC managers to check when and which strategies and action plans shall be rolled out and for stakeholders to plan their own actions in accordance with the NSMP roll-out schedule.



Malaysian Slope Safety System by End of NSMP

After the strategies and action plans are drafted and sequenced in order of priority, the final question remains: what will the Malaysian Slope Safety System by the year 2023 look like?

This can be answered by defining the goals of the vision of the Malaysian Slope Safety System. By the end of 2023, the Malaysian system shall have the goals and visions as described as follows.

NSMP Goals

Thrust 1: Assessing Landslide Risks

Goals: Hazard and risk mapping, analysis and assessment of high-risk areas identified in the NSMP has been carried out. By this time, there would be hazard and mapping information for another 11 hotspot areas within the country. Also by 2023, our understanding of risk would be much better and representative of the complex, geological, tectonic, and environmental conditions of Malaysia.

Thrust 2: Investing in Risk Reduction

Goals: Provide a two-day early warning at regional scale. Federal and local agencies in high-risk areas to carry out awareness and education programs. Retrofitting has been carried out for a number of existing risky slopes as identified in the risk maps and prioritised yearly to accommodate changing land use and new urban developments

Thrust 3: Promoting Good Governance

Goals: Landslide risk reduction have been incorporated into development policies in other sectors. Fully-empowered local authorities with legal backing for enforcement. Networking among agencies for information-sharing. Sufficient resources (funds and manpower). Public and private cost-sharing initiatives. All the main guidelines for planning, design, construction, maintaining and loss assessment have been established and adopted. Establish and implement training for practitioners and post-graduate programs.

Thrust 4: Preparing for Response & Recovery

Goals: All data required by emergencies managers will be available. All communities in high-risk areas must know and have carried out drills for landslide emergencies.

Thrust 5: Spurring Innovation

Goals: Coordinated research network established among researchers nationwide. All applied research undertaken must be applicable for adoption by practitioners. Promote high-impact research and innovation by multi-, inter-, and trans-disciplinary disaster research approach towards building a resilient nation.

Vision of Slope Management in the Future

With strategies of the NSMP carried out by 2023, the slope management scenario in Malaysia would have achieved the following goals:

Policy and Institutional Framework

- Relevant slope policies have been amended, mainstreamed and used by local authorities for their empowerment to act on slope issues
- Coordination and implementation among government agencies and relevant stakeholders through working committees
- CKC established as technical reference centre in slope management
- Shared responsibility and costing among slope stakeholders

Hazard Mapping and Assessment

Hazard and risk mapping and assessment have been carried out in all areas identified in the NSMP. However, more area-based landslide hazard and risk mapping in municipalities need to be carried out. In this phase of the NSMP, quantitative risk assessment will be adopted given the availability of high-resolution topographic data, good triggering data spatially and temporally, complete landslide historical data and field data as well as robust landslide models using statistical, deterministic, empirical or physical modelling approaches.

Early Warning and Real-Time Monitoring Systems

Two day's advance warning of landslides on soil slopes.

Loss Assessment

All relevant local authorities to fill out loss assessment proformas for every landslide incident and submit to CKC.

Information Collection, Interpretation, Dissemination and Archiving

Disaster managers and emergency first responders shall have instant access to real-time and archived data on slopes for purposes of search and rescue and other response and recovery functions.

Training

Increased level of professionalism and skills among CKC and slope industry as a whole.

Public Awareness

Communities shall have slope monitoring programs working in conjunction with local authorities in key high-risk areas and flat lands where there is proliferation of urban/slope development.

Landslide Prevention Measures

- Retrofit a number of existing risky slopes as identified in the risk maps and prioritised yearly to accommodate changing land use and new urban developments
- Established and standardised set of guidelines, procedures, requirements and codes of geotechnical engineering for slopes
- Good practices as stipulated by CKC are being followed by slope practitioners
- Sustainable slopes are proliferating throughout the country

Emergency Preparedness, Response and Recovery

- Preliminary incident reports prepared in less than three days
- Rescue of all landslide victims within three hours
- Slope engineers to have instant access to slope info in an emergency
- High-risk communities to be able to initiate emergency SOPs in a landslide disaster
- Shorter recovery because of built-in resilience

Research and Development

Identified, launched and made feasible all applied research projects per year. Research will be focused on high impact and innovation through multi-, inter-, and trans-disciplinary approach, especially aiming towards disaster resilience. A strong local research network with the support of grant, funding, and resources.

Sustainable Slope Practices

Identified, launched and widespread adoption of sustainable slope works by practitioners throughout the country

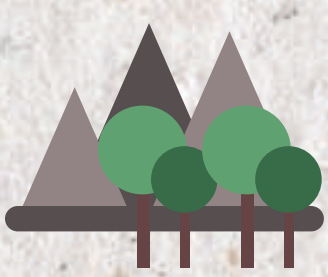
THE SLOPE MANAGEMENT ROAD MAP

SLOPE MANAGEMENT ROAD M

The Journey

The journey for slope management for the next 7 years shall encompass 3 phases. The first, from 2017 to 2018, involves the setting of standards, procedures, and guidelines into place. Hazard and risk mapping activities of major high-risk areas shall also be done at this stage. This sets the stage for the second phase, which spans 2019 to 2020, which is disseminating and mainstreaming the basic foundation material established in the first phase. The final phase and stretch to the goal line, from 2021 to 2023, involves full-swing activities in structural and non-structural measures towards landslides risk reduction. By this time, a systematic retrofitting program would have been started based on the maps created in Phases 1 and 2, and systems such as early warning and loss assessment will have been developed for efficient and effective delivery of services.

For more details on the activities per year, refer to the Action Plan Chapter of the 2016 Review of the National Slope Master Plan.



2022

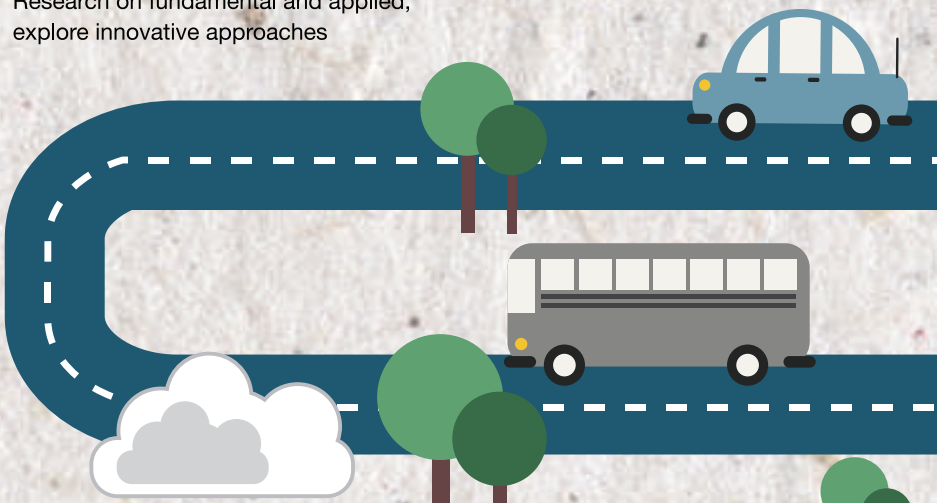
Theme: Create Linkages, Consolidate, and Network for Effective Implementation

Disseminate standard guidelines to state and local authorities
Extend networking and information services
Research on fundamental and applied, explore innovative approaches

2020

Theme: Disseminate and Mainstream

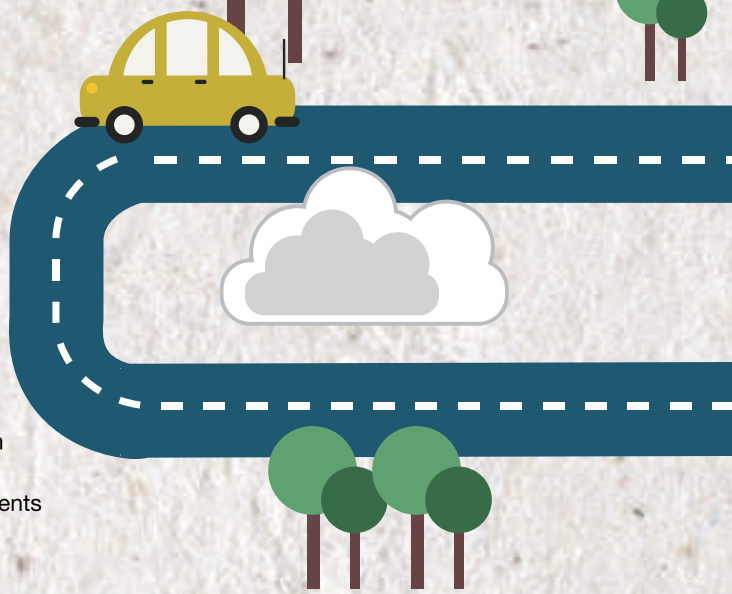
Disseminate standard guidelines to state and local authorities
Landslide DRR to be incorporated in strategic plans for various sectors
Extend and expand networking, information and early warning services
Public awareness dissemination through local and district authority levels
Continue systematic retrofitting
Carry out research needed to implement the action plans



2018

Theme: Mapping, Standards, Procedures and Guidelines

Develop inventories and maps
Develop standard guidelines
Develop standard procedures
Set up infrastructure of databases
Public awareness and education
Set up infrastructure for early warning system
Set up working committee
Establish modules and curriculum enhancements
Carry out research needed to implement the action plans



AP

JKR

CAWANGAN KEJURUTERAAN
CERUN JKR MALAYSIA

CERUN YANG SELAMAT • MENYELAMATKAN NYAWA

2023
SLOPE GOAL

Achievement of Goals
NATIONAL SLOPE MASTER PLAN

2021

Theme: Create Linkages, Consolidate, and Network for Effective Risk Reduction

Fine grain existing databases and systems for higher efficiency and performance
Extend networking and information services
Commence systematic retrofitting
Commence pilot programs based on successful research

2019

Theme: Disseminate and Mainstream

Disseminate standard guidelines to state and local authorities
Landslide DRR to be incorporated in strategic plans for various sectors
Extend and expand networking, information and early warning services
Public awareness dissemination through local and district authority levels
Commence systematic retrofitting
Carry out research needed to implement the action plans

2017

Theme: Mapping, Standards, Procedures and Guidelines

Develop inventories and maps
Develop standard guidelines
Develop standard procedures
Set up infrastructure of databases
Public awareness and education
Set up infrastructure for early warning system
Set up working committee
Set up research agenda
Set up training agenda
Set up SIGs and networks/platform for discussion


IMPROVEMENT
CHECK
OBJECTIVE
ACTION PLA
OLLABORATION

ACTION PLAN

2017-2023 STRATEGIES AND ACTION PLANS BY YEAR

Thrust 1: Assessing Landslide Risk		Costing (in RM '000)						
	Action Plan	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Develop and update national inventories of known landslides throughout the country	Plan and carry out data collection	5,000	5,000	2,000	2,000	2,000	2,000	2,000
	Prepare landslide inventory map	250	250	100	100	100	100	100
Develop standard guidelines for landslide hazard and risk mapping and assessment	Develop standard procedures for hazard and risk assessment and mapping	62.5	62.5	62.5	62.5	0	0	0
	Develop standard procedures for qualitative and quantitative risk assessment	125	125	125	125	0	0	0
Develop a plan for mapping and assessing landslide hazard and risks	Mapping and prepare hazard and risk maps	12,500	12,500	5,000	5,000	5,000	5,000	5,000
	Establish and carry out a consistent approach for assessing landslide risks that will provide uniform information	250	250	250	250	0	0	0
	Set the level of "acceptable risk" in slope management, including quantitative risk assessment	600	600	600	600	600	600	600
	TOTAL PER YEAR	**18,787.50**	**18,787.50**	**8,137.50**	**8,137.50**	**7,700**	**7,700**	**7,700**

TOTAL FOR THRUST: RM76,950,000 (RM77 Million)

Thrust 2: Investing in Risk Reduction		Costing (in RM '000)						
	Action Plan	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Setting up of National and Regional EWS Infrastructure	Develop Early Warning and Real Time Monitoring network structures based on landslide models	2,500	2,500	0	0	0	0	0
	Group each prioritize areas based on the risk maps landslide prone areas in terms of its common geological and rainfall patterns	2,500	2,500	0	0	0	0	0
	Develop regional scale real time monitoring system	2,500	2,500	0	0	0	0	0
	Develop site specific scale real time monitoring system	2,500	2,500	0	0	0	0	0
Integration of JKR, JMM and JPS Rain Gauge Stations	Automation of all rainfall data acquisition stations	2,500	2,500	0	0	0	0	0
	Networking of all rain gauge stations	500	500	200	200	200	200	200
Enhancement of JMM Rainfall Forecasting Capacity	Upgrading and new installations of Doppler Radar	0	10,000	10,000	10,000	10,000	10,000	0
	Inclusion of the numerical weather predictor (NWP) in forecasting	1,000	1,000	0	0	0	0	0
Set up the system infrastructure of databases with slope catalogue and site investigation records	Establish the system infrastructure	1,000	1,000	0	0	0	0	0
	Establish the data quality management control	0	0	400	400	400	400	400
	Set up the slope catalogue database, site investigation database of landslide events, and slope maintenance	1,000	1,000	0	0	0	0	0
Provide linkages among systems	Integrate the hazard and risk system, loss assessment model system and early warning systems	0	0	400	400	400	400	400
Build and maintain public awareness capabilities of implementing agencies	Custodian agency to maintain the public communication function	0	0	0	0	0	0	0
	Produce marketing collateral for each target group	300	300	300	300	300	300	300
Conduct public awareness programs based on user needs requirements	Develop appropriate methods and implement programs to the target groups for implementation by custodian and relevant external agencies	3,000	3,000	3,000	3,000	3,000	3,000	3,000
	Explore and deploy technologies and innovative methods for effective implementation of awareness and education initiatives and programs	250	250	250	250	250	250	250
Start a landslide preventive measure program to address existing slopes	Commence routine maintenance inspection and works	200,000	200,000	200,000	200,000	200,000	200,000	200,000
	Prioritise and retrofit existing man-made and natural slopes	200,000	200,000	200,000	200,000	200,000	200,000	200,000
	TOTAL PER YEAR	**419,550**	**429,550**	**414,550**	**414,550**	**414,550**	**414,550**	**404,550**

TOTAL FOR THRUST: RM2,911,850 (RM2.9 Billion)

Continued

Thrust 3: Promoting Good Governance		Costing (in RM '000)						
	Action Plan	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Operationalize multi-sectoral and integrated slope management mechanisms	Establish and maintain co-ordinating committees on slope management at the national, state and local authority levels(PIF (Allocate for conference/workshops?)	0	0	0	0	0	0	0
	Identify funding sources and provide budgetary allocation for slope and disaster management (PIF)	0	0	0	0	0	0	0
	Explore and adopt innovative methods of sharing and transferring the costs associated with landslide risk reduction and disasters to alleviate the burden on the state (PIF)	2,500	2,500	1,250	1,250	1,250	1,250	1,250
	Set up a network of government departments, local authorities, disaster management agencies, research institutions, disaster management specialists, NGOs, community groups, and other stakeholders to augment their capabilities and encourage best practices(PIF)	0	0	0	0	0	0	0
	Co-operate with international agencies for the sharing and dissemination of knowledge in slope and disaster management and for assistance of expertise and resources in slope and disaster management (PIF)	0	0	0	0	0	0	0
Integrate landslide risk assessment and risk reduction planning into development policies and planning at all levels of government and industry	Ensure that the planning activities of federal, state and local authorities take into account slope protection and landslide risk reduction (PIF)	0	0	0	0	0	0	0
Formulate and amend legislation to support and promote landslide risk reduction	Formulate/modify appropriate legislation and guidelines for better slope and landslide disaster management and to improve the professionalism of geologists, especially in the assessment of slope hazards (PIF)	0	0	1,000	1,000	1,000	1,000	1,000
Build strong capabilities, expertise and networking in slope management	Strengthen CKC to become a Slope Engineering Agency including strategic regional centres, with adequate support, capabilities, expertise and power in developing and streamlining slope management activities (PIF)	0	0	0	0	0	0	0
Establish mandatory requirement for submission of landslide costs	Establish procedures for data compilation, integration and dissemination (LA)	100	100	0	0	0	0	0
	Compile and analyse loss data (LA)	250	250	200	200	200	200	200
	Institute the requirements and purpose of landslide insurance coverage towards funding for insurance pool (LA)	150	150	0	0	0	0	0
Provide uniform guidelines for initial on-site damage assessment and relief expenses	Provide guidelines for assessing needs of victims and potential financial losses of affected area (LA)	175	175	0	0	0	0	0
	Conduct financial assessment by local authorities on the recovery of rescue and relief costs (LA)	250	250	200	200	200	200	200
	Provide guidelines for recovery of rescue and relief costs (LA)	75	75	0	0	0	0	0

Continued

Thrust 3: Promoting Good Governance		Costing (in RM '000)						
	Action Plan	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Develop, coordinate and conduct training modules for relevant stakeholders	Develop and conduct technical training modules related to slope works(TRN)	1,221	1,221	1,221	1,221	1,221	1,221	1,221
	Develop and conduct administrative management training modules related to slope works(TRN)	286	286	286	286	286	286	286
	Develop and conduct emergency response training modules related to slope failure emergency (TRN)	750	750	750	750	750	750	750
Develop specialized university courses and programs for slope engineering	Develop specialized university courses and programs for slope engineering (TRN)	0	0	0	0	0	0	0
Develop necessary framework and guidelines for best slope management practices	Set up a working committee at federal and state levels (LPM)	0	0	0	0	0	0	0
	Develop and implement a detailed framework for best slope management practices (LPM)	0	0	0	0	0	0	0
	Produce, review and update guidelines for planning, design, construction and maintenance (LPM)	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	Create checklists to verify, planning, design, construction and maintenance (LPM)	0	0	0	0	0	0	0
	Create and update guidelines for sustainable slope practices (LPM)	0	0	500	200	200	200	200
Incentivize practitioners to encourage best practices in slope management and engineering	Create and implement incentive schemes for developers, engineers and contractors (LPM)	700	700	700	350	350	350	350
	Assess the viability of putting sustainable slope practices into actual use through pilot programs and create awareness for adoption by local practitioners and other players in the slope industry sector (LPM)	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Develop a national plan to adopt landslide mitigation technology	Encourage the set-up of a Special Interest Group (SIG) for sharing of latest landslide mitigation technologies among practitioners on the latest technologies (LPM)	1,000	200	200	200	200	200	200
	TOTAL PER YEAR	**9,457**	**8,657**	**8,307**	**8,007**	**8,007**	**8,007**	**8,007**

TOTAL FOR THRUST: RM58,449,000 (RM58 Million)

Thrust 4: Assessing Landslide Risk		Costing (in RM '000)						
	2017	2017	2018	2019	2020	2021	2022	2023
Extend the System for use during and after landslides for the emergency managers	Extend the System dissemination services through mobile devices on selected secure communication modes (ICIDA)	0	0	5,000	5,000	5,000	5,000	5,000
	Extend the System for use at any emergency control centres (ICIDA)	0	0	5,000	5,000	5,000	5,000	5,000
Improve the accuracy and timeliness of the information	Enhance existing modules for emergency managers, planners and designers (ICIDA)	0	0	10,000	10,000	10,000	10,000	10,000
Develop capacity for quality emergency response and recovery	Define and update clear policies, mechanisms and procedures (EPRR)	0	0	0	0	0	0	0
	Identify and audit availability of deployable suitable equipment at landslide prone areas (EPRR)	1,525	1,525	120	120	120	120	120
	Conduct inter-agency drills among various emergency response agencies for landslides (EPRR)	20	20	20	20	20	20	20
	Shorten the days of preparation of preliminary report for disasters to less than 3 days (EPRR)	0	0	0	0	0	0	0
Provide necessary geotechnical support, advice and forensic in landslide emergencies	Provide adequate and immediate support to emergency managers (EPRR)	0	0	0	0	0	0	0
	Provide advisory and forensic services and help to bring the affected infrastructures into near normal operating conditions (EPRR)	0	0	0	0	0	0	0
	TOTAL PER YEAR	**1,545**	**1,545**	**20,140**	**20,140**	**20,140**	**20,140**	**20,140**

TOTAL FOR THRUST: RM103,790,000 (RM104 Million)

Thrust 5: Spurring Innovation		Costing (in RM '000)						
	2017	2017	2018	2019	2020	2021	2022	2023
Encourage joint research programs on landslides with established research organizations	Develop methodology for data modelling and analysis for socioeconomic assessment (R&D)	250	250	500	500	500	500	500
	Conduct research on landslide numerical simulation system showing the extent of damage to lives and property of potential landslides (R&D)	0	0	5,000	5,000	5,000	5,000	5,000
	Research and explore new and innovative approaches to sustainable slopes (SSP)	700	700	700	700	700	700	700
	Develop and implement a national research agenda for slopes for fundamental and applied research (R&D)	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	Set up a research network for periodic reviews and journals, practitioner feedback and peer evaluation (R&D)	50	50	100	100	100	100	100
Collaborate with funding agencies to give priority to slope research	Coordinate with funding agencies to fund research identified in the national agenda (R&D)	0	0	0	0	0	0	0
	TOTAL PER YEAR	**2,000**	**2,000**	**7,300**	**7,300**	**7,300**	**7,300**	**7,300**

TOTAL FOR THRUST: RM40,500,000 (RM40 Million)

TOTAL FOR IMPLEMENTING 2017 COUNTER MEASURES IS RM 3,191,539,000 (RM 3.2 billion).

Without retrofitting works, it would be RM 391 million

APPENDIX A

ABBREVIATION AND ACRONYMS

LIST OF ACRONYMS
TECHNICAL AND GENERAL TERMS

BAHASA MELAYU		ENGLISH	
AYAT-AYAT		TERMS	
		AAD	Average Annual Damages
		AAL	Average Annualised Loss
		CATs	Catastrophe Bonds
		CBA	Cost Benefit Analysis
		CPD	Continuous Professional Development
		DFEM	Discrete Finite Element Method
		DLP	District Local Plans
		ECC	Emergency Control Centre
		EDGS	Enhanced Data GSM Evolution
		EMP	Environmental Management Plan
	Kesiapsiagaan, Respon dan Pemulihan Kecemasan	EPRR	Emergency Preparedness, Response and Recovery
		ESMas	Expressway Slope Maintenance Management
	Amaran Awal dan Pematauan Masa Nyata	EW & RTMS	Early Warning and Real-Time Monitoring System
	Sistem Amaran Awal	EWS	Early Warning System
		FEM	Finite Element Method
		FIT	Flood Information Tool
		FORM	First Order Reliability Method
		FOSM	First Order Second Moment Approximation
		FYMP	Five Year Malaysia Plan
		GDP	Gross Domestic Product
		GPRS	Global Packet Radio Service
		GSM	Global System Mobile Communication
		HAZUS	Natural Hazard Loss Estimation Methodology
		HKD	Hong Kong Dollar
	Penilaian dan Pemetaan Bahaya	HMA	Hazard Mapping and Assessment
		HPC	High Powered Committee on Disaster Management
	Pengumpulan, Pentafsiran, Penyebaran dan Perolehan Maklumat	ICIDA	Information Collection, Interpretation, Dissemination and Archiving
		ICS	Incident Command System
		ICT	Information and Communication Technology
		IDLHZ	Inventory/Database on Landslide Hazard Zone
		IMF	International Monetary Fund
		IRPA	Intensification of Research in Priority Areas
		ITC	Geoinformation Science and Earth Observation
	Taksiran Kerugian	LA	Loss Assessment
		LiDAR	Airborne Light Detection and Ranging System
		LIP	Landslide Interoperability Project
	Had Cecair	LL	Liquid Limit

BAHASA MELAYU		ENGLISH	
AYAT-AYAT		TERMS	
		LMS	Landslide Motion Survey
		LREIS	Laboratory of Resources and Environmental Information System
	Langkah - Langkah Pengurangan Kerugian	LRM	Loss Reduction Measures
		MEHMS	Malaysian Engineered Hill Slope Management System
		NADDI	National Disaster Data and Information Management System
		NDRP	National Disaster Reduction Plan of the People
	Badan Bukan Kerajaan	NGO	Non-Governmental Organisation
		NIDP	National Institute for Disaster Prevention
		NPP	National Physical Plan
		NPV	Net Present Value
	Kesedaran Awam dan Pendidikan	PAE	Public Awareness and Education
	Indeks Plastik	PI	Plastic Index
	Polisi dan Rangkakerja Institusi	PIF	Policies and Institutional Framework
	Had Plastik	PL	Plastic Limit
		QRA	Quantitative Risk Assessment
		RAM	Victorian Rapid Appraisal Method
		RM	Ringgit Malaysia
	Penyelidikan dan Pembangunan	RND	Research and Development
		RSDM	Russian System on Disaster Management
	Sistem Pemantauan Masa Nyata	RTMS	Real-Time Monitoring System
		SAIS	Slope Asset Information System
		SAR	Search and Rescue Operation
	Penyiasatan Tanah	SI	Soil Investigation
		SIMS	Slope Information Management System
		SIS	Slope Information System
	Sistem Pesanan Ringkas	SMS	Short Messaging System
		SPRS	Slope Priority Ranking System
		SSP	State Structure Plans
		TCPA	Town and Country Planning Act
		TDMA	Time Division Multiple Access
		TDR	Time Domain Reflectometer
		TEC	Total Estimated Cost
	Latihan	TRN	Training
		UNDP	United Nations Development Programme
		USD	United States Dollar
		VPN	Virtual Private Network

LIST OF ACRONYMS GOVERNMENT AGENCIES, **COMPANIES AND ORGANISATIONS IN ENGLISH**

BAHASA MELAYU		ENGLISH	
AGENSI-AGENSI KERAJAAN DAN ORGANISASI-ORGANISASI		GOVERNMENT AGENCIES AND ORGANISATIONS	
		ACEM	Association of Consulting Engineers Malaysia
		ADMIT	Asian Disaster Mitigation Training Network
		ADPC	Asian Disaster Preparedness Centre
		AEG	Association of Environmental & Engineering Geologists
		AGS	Australian Geomechanics Society
	Lembaga Jurutera Malaysia	BEM	Board of Engineers Malaysia
		BRO	Border Roads Organisation
		BTE	Bureau of Transport Economic
		CEDD	Civil Engineering and Development Department
		CIDB	Construction Industry Development Board
		CRISP	Centre for Remote Imaging, Sensing and Processing
		DDMRC	District Disaster Management and Relief Committee
	Jabatan Pengairan dan Saliran	DID	Department of Irrigation and Drainage
		DMC	Disaster Management Centre
	Jabatan Alam Sekitar	DOE	Department of Environment
		DPRI	Disaster Prevention Research Institute
		ECC	Emergency Control Centre
		EMA	Emergency Management Australia
		EMERCOM	Emergencies and Elimination of Consequences of Natural Disasters
		EPA	Environmental Protection Agency
		FEMA	Federal Emergency Management Agency
		FHWA	Federal Highway Administration
		GEO	Geotechnical Engineering Office (Hong Kong or Brazil)
		HKIE	Hong Kong Institution of Engineers
		ICL	International Consortium on Landslides
		IDMC	International Ministerial Committee for Disaster Management
		IEM	Institution of Engineers Malaysia
		LESTARI	Institute for Environment and Development
	Pusat Remote Sensing Negara	MACRES	Malaysian Remote Sensing Agency
	Lembaga Lebuhraya Malaysia	MHA	Malaysia Highway Authority
	Kementerian Pertahanan Malaysia	MINDEF	Ministry of Defence
		MINT	Malaysian Institute for Nuclear Technology Research
		MLIT	Ministry of Infrastructure, Land and Transport
		MOSTI	Ministry of Science Technology and Innovation
		MTD-RC	Mountainous Terrain Development Research Centre
		NASEC	National Soil Erosion Research Centre

BAHASA MELAYU		ENGLISH	
AGENSI-AGENSI KERAJAAN DAN ORGANISASI-ORGANISASI		GOVERNMENT AGENCIES AND ORGANISATIONS	
		NIBS	National Institute of Building Sciences
	Bahagian Keselamatan Negara	NSD	National Security Division
	Projek Lebuhraya Utara-Selatan	NSE	North-South Expressway Project
		NTES	Northern Territory Emergency Service
		OCIPEP	Office of Critical Infrastructure Protection and Emergency Preparedness
	Persatuan Insurans Am Malaysia	PIAM	Malaysia General Insurance Association
	Jabatan Kerja Raya Malaysia	PWD	Public Works Department
		RCL	Research Centre on Landslide
		SDMRC	State Disaster Management and Relief Committee
		SEA	Slope Engineering Agency
		SEDC	State Economic Development Corporation
		SEPU	State Economic Planning Unit
		SMART	Special Malaysia Disaster Assistance and Rescue Team
		SSO	State Secretary Office
	Jabatan Perancangan Bandar dan Desa	TCPD	Town and Country Planning Department
	Pertubuhan Bangsa - Bangsa Bersatu	UN	United Nations
		USGS	United States Geological Survey
		WWF	World Wildlife Fund

LIST OF ACRONYMS GOVERNMENT AGENCIES, **COMPANIES AND ORGANISATIONS IN BAHASA MALAYSIA**

BAHASA MELAYU		ENGLISH	
AGENSI-AGENSI KERAJAAN DAN ORGANISASI-ORGANISASI		**GOVERNMENT AGENCIES AND ORGANISATIONS**	
ATM	Angkatan Tentera Malaysia		Malaysian Armed Forces
BKN	Bahagian Keselamatan Negara		
CKC	Cawangan Kejuruteraan Cerun, JKR		Slope Engineering Branch, PWD
DBKL	Dewan Bandaraya Kuala Lumpur		Kuala Lumpur City Hall
IKRAM	Kumpulan IKRAM Sdn Bhd		
JAS	Jabatan Alam Sekitar		Department of Environment
JBPM	Jabatan Bomba dan Penyelamat		Fire and Rescue Department
JKM	Jabatan Kebajikan Masyarakat		Department of Social Welfare
JKR	Jabatan Kerja Raya Malaysia		Department of Public Works
JMG	Jabatan Mineral dan Geosains		Minerals and Geoscience Department
JMM	Jabatan Meteorologi Malaysia		Malaysia Meteorological Department
JPA3	Jabatan Pertahanan Awam		Department of Civil Defence
JPS	Jabatan Pengairan dan Saliran		Department of Irrigation and Drainage
JUPEM	Jabatan Ukur dan Pemetaan Malaysia		Department of Survey and Mapping Malaysia
KEMENTAH	Kementerian Pertahanan Malaysia		Malaysia Ministry of Defence
KPKT	Kementerian Perumahan dan Kerajaan Tempatan		Ministry of Housing and Local Government
LLM	Lembaga Lebuhraya Malaysia		Malaysia Highway Authority
MPAJ	Majlis Perbandaran Ampang Jaya		Ampang Jaya Municipal Council
APBN	Agensi Pengurusan Bencana Negara	NADMA	National Disaster Management Agency
PBB	Pertubuhan Bangsa - Bangsa Bersatu	UN	United Nations
PBSM	Persatuan Bulan Sabit Merah		Malaysian Red Crescent Society
PDRM	Polis Diraja Malaysia		Royal Malaysian Police
PLUS	Projek Lebuhraya Utara-Selatan		North-South Expressway
RTM	Radio Television Malaysia		
STMB	Syarikat Telekom Malaysia Berhad		
TNB	Tenaga Nasional Berhad		
UiTM	Universiti Teknologi MARA		
UM	Universiti Malaya		University of Malaya
UPC	Unit Pengurusan Cerun		
UPM	Universiti Putra Malaysia		
USM	Universiti Sains Malaysia		
UTM	Universiti Teknologi Malaysia		

APPENDIX B

LIST OF ACKNOWLEDGEMENTS

LIST OF **ACKNOWLEDGEMENTS**

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