DAM MANAGEMENT IN MALAYSIA

Flood Risk Management Case Visit

by

ASEAN Committee on Disaster Management (ACDM)

8th JULY 2019

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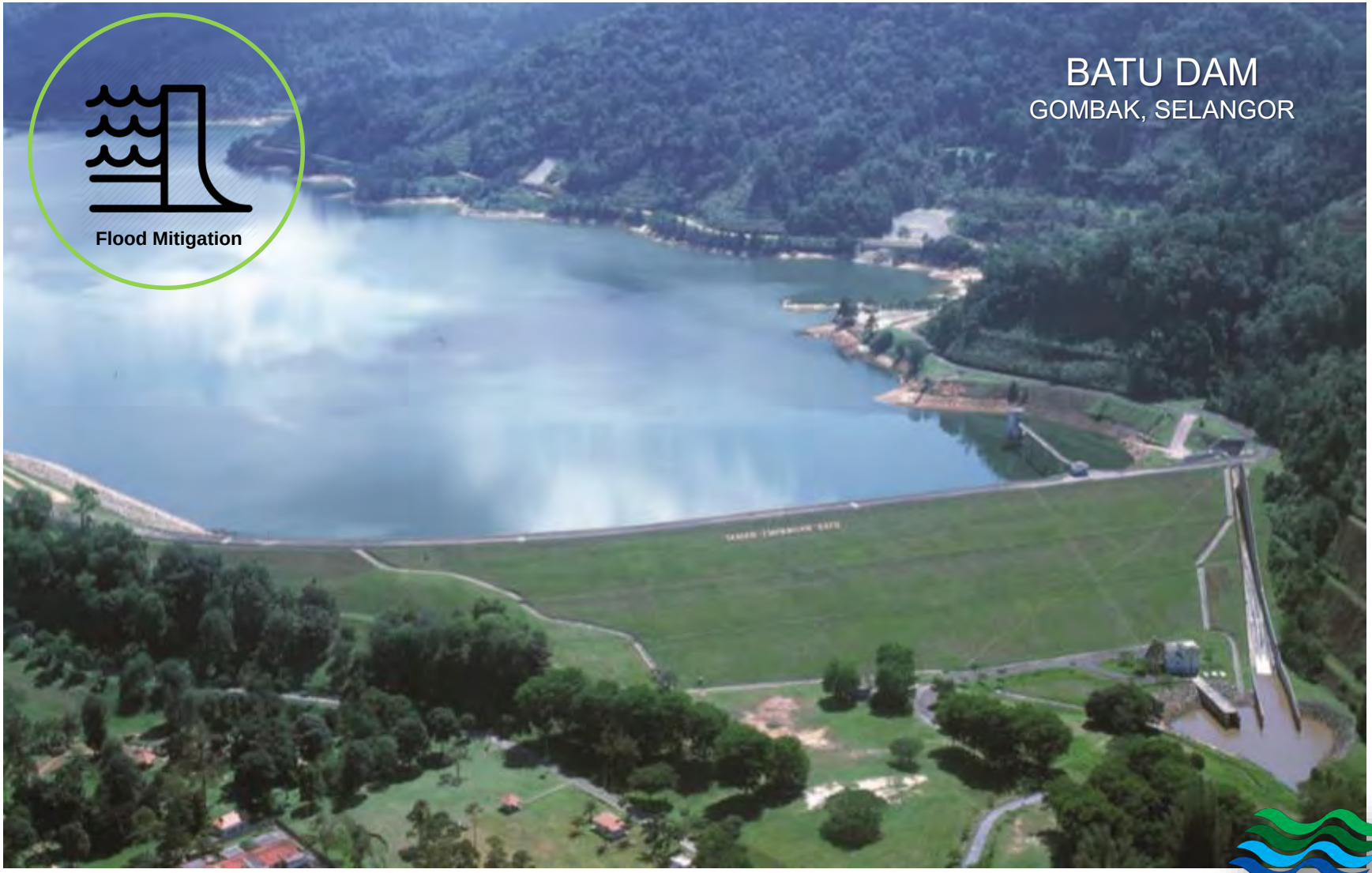
CONTENTS

- Dams in Malaysia
- Dam Safety Issues
- Government initiatives and Action Plan
- Future Direction

Introduction – Dams in Malaysia



DAM

"All man-made barriers, together with appurtenant works, constructed for storage or control of water or other fluids".

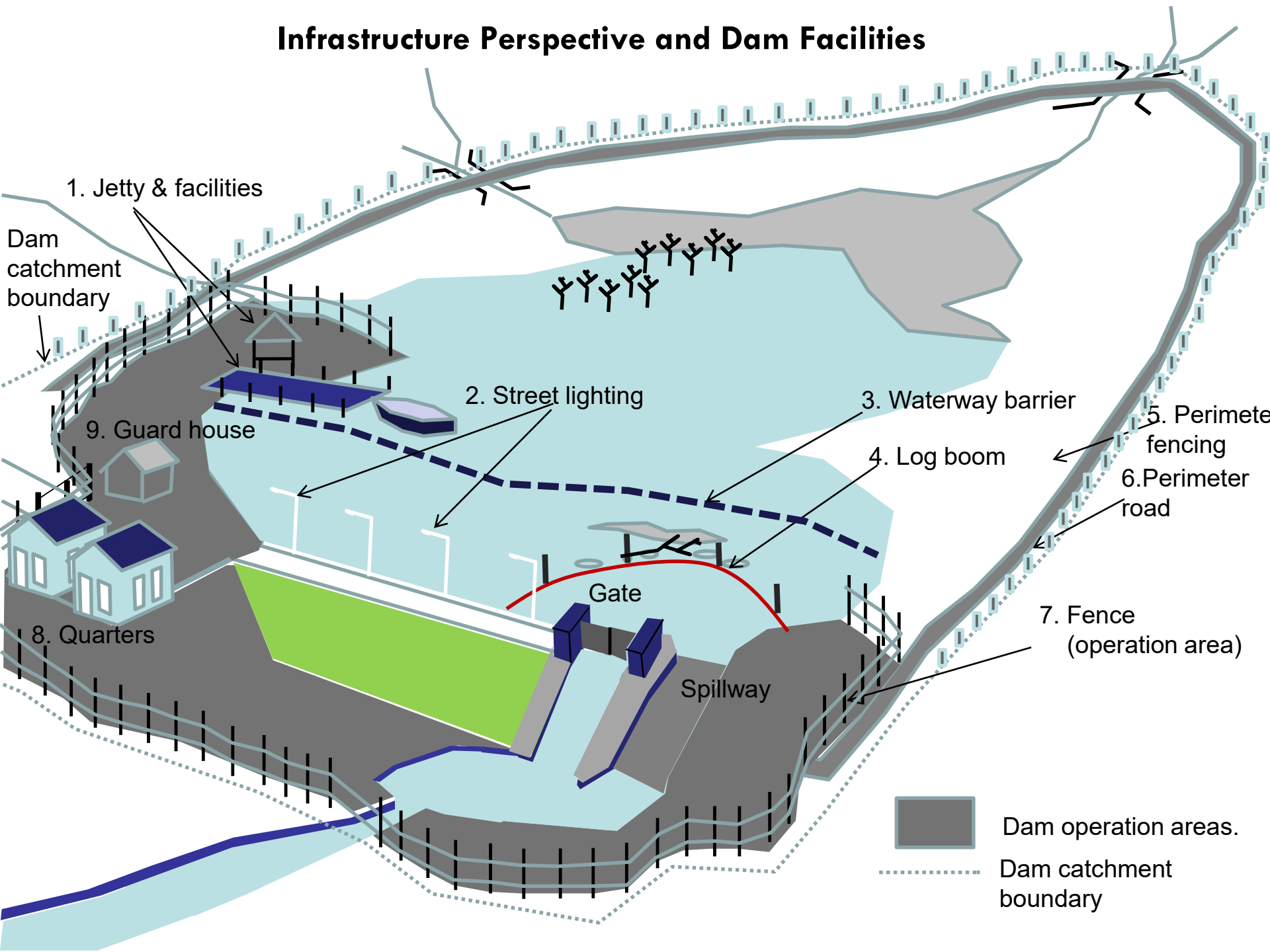
- This classification normally **excludes canals and levees**, but MyDAMS may be used as a basis for developing safety management plans for these structures, if the need exists.

- Applicable to dams that are **10 m or more** in height and storage more that **20,000 m^3**

  Or;

  dams that higher than **5 m** and storage more than **50,000 m^3**

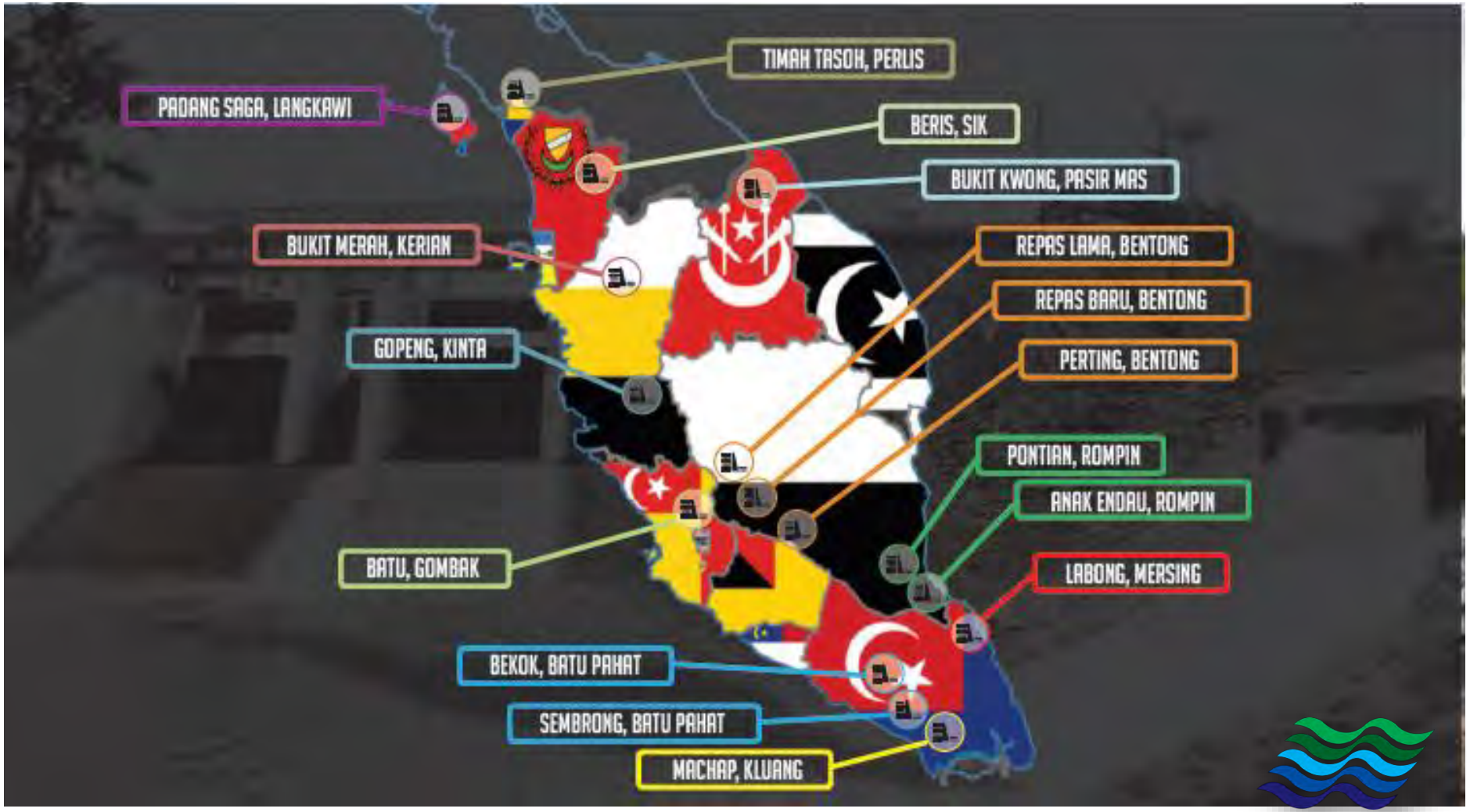
***Malaysia Dam Safety Management Guideline (MyDAMS)**


Infrastructure Perspective and Dam Facilities
1. Jetty & facilities
Dam catchment boundary
2. Street lighting
3. Waterway barrier
4. Log boom
5. Perimete fencing
6.Perimeter road
9. Guard house
Gate
7. Fence (operation area)
8. Quarters
Spillway
Dam operation areas.
Dam catchment boundary

Dams in Malaysia

States	Total no.	Water Supply	Irrigation	Flood Mitigation	Hydroelectricity	Sedimentation	Recreation
Johor	17	13	1	3			
Kedah	8	2	5				
Kelantan	2		1		1		
N. Sembilan	8	7	1				
Melaka	5	4					1
Pahang	11	4	2		2	3	
P. Pinang	4	4					
Perak	10	2	1		6	1	
Perlis	1			1			
Selangor	9	6	2	1			
Terengganu	6	3	1		2		
Sabah	10	8			2		
Sarawak	9	6			3		
Labuan	3	3					
Putrajaya	1						1
TOTAL	**104**	**62**	**14**	**5**	**16**	**4**	**2**

16 Dams under DID



Overview

- Average age of dams has exceeded 40 years.
- Majority dam are earth fill dam.
- Own by different agencies.

The main function:

1. Raw water supplier
2. Irrigation
3. Flood mitigation
4. Generating hydro-electricity
5. Impediment to sediment and silts (silt retention)

Some interesting facts

WATER SUPPLY SECTOR

- Water supply has the most number of dams (65 dams).
- Total storage about 2,400 MCM.
- Biggest dam is Linggiu Dam in Johore (760 MCM).
- Largest in term of surface area is Chereh Dam in Pahang (16 km^2).
- Highest water supply dam is Selangor Dam at 110 m.

References: Dam in Malaysia, 2014, RPM Engineer Sdn, Bhd.

Some interesting facts

HYDROPOWER SECTOR

- 16 Hydropower Dams.
- Biggest capacity dams with total storage about 80,000 MCM.
- Bakun Dam is the largest dam (44,000 MCM).
- Bakun Dam is listed by ICOLD as ranked at 41 out of 60 highest dam in the world.
- Kenyir Dam (Terengganu) is the second largest dam in Malaysia (13,600 MCM, surface area of 369 km^2, height 155 m).

References: Dam in Malaysia, 2014, RPM Engineer Sdn, Bhd.

Some interesting facts

IRRIGATION SECTOR

- 14 dams with total storage about 2,000 MCM.
- Pedu Dam is the largest volume at 1,073 MCM .
- Pedu Dam is largest surface area at 84 km^2.

FLOOD MITIGATION

- 5 dams with total storage of 130 MCM.
- **Timah Tasoh** Dam is the largest with 33 MCM capacity. (Will increase to 87 MCM, once dam upgrading project completed)
- The highest flood mitigation dam is **Batu Dam** at 44 m.

References: Dam in Malaysia, 2014, RPM Engineer Sdn, Bhd.

Dam Built in Various Periods

Period	No. of Dams Built	Period	No. of Dams Built
< 1900	17	-	-
1901 - 1910	1	1961-1970	10
1911-1920	0	1971-1980	6
1921-1930	2	1981-1990	28
1931-1940	9	1991-2000	12
1941-1950	2	2001-2010	18
1951-1960	3	2011-2016	12

Distribution of Dams According to Dam Type

Item	Dam Type	No.	Percentage (%)
1	Earth fill	70	66
2	Rock fill	14	13.2
3	Concrete gravity	18	17
4	Others	4	3.8

Dam Hazard Rating

Dam Hazard Rating	PAR[1,2]	Environmental and cultural values[2]	Infrastructure and economics[2]
Low	0	Minimal short-term loss; No long-term loss	Low economic losses; Area contains limited infrastructure or services
Significant	1 – 10	No significant loss; Marginal deterioration of important flora and fauna habitat; Restoration is highly possible	Significant economic losses involving recreational facilities, infrequently used workplaces and transportation routes
High	11 – 100	Significant loss or deterioration of critical flora and fauna habitat Restoration is possible but impractical	High economic losses affecting infrastructure, public transportation and commercial facilities
Very high	> 100	Major loss or deterioration of critical flora and fauna habitat Restoration is impossible.	Very high economic losses affecting important infrastructure or services (e.g. hospital, highway, industrial area, storage facilities for dangerous substances)

Note 1: Definitions for Population at Risk (PAR):

The number of people who would be directly exposed to inundation greater than 0.5 m in depth within the dam break affected zone if they took no action to evacuate.

Note 2: Inference for PAR, environment and cultural values, and infrastructure and economic losses:

Losses or damages stated above are incremental, which dam failure might inflict on, are over and above any losses which might have occurred for the same natural event or conditions, had the dam not failed.

***Malaysia Dam Safety Management Guideline (MyDAMS)**

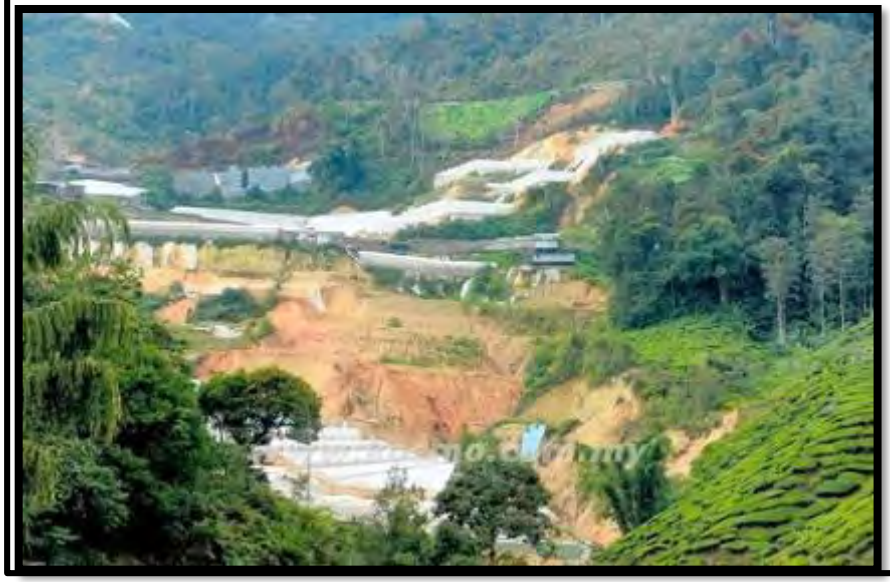
Surveillance Inspection

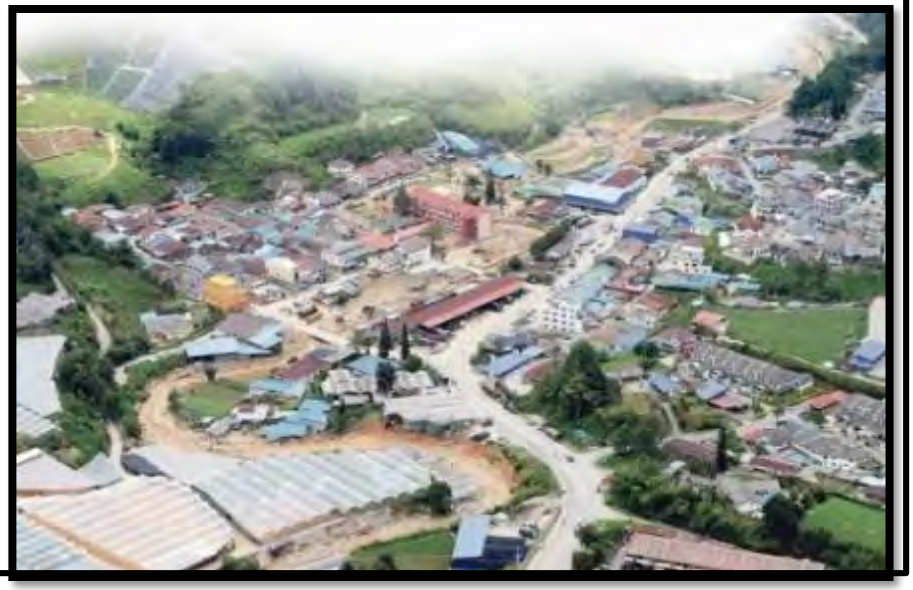
Dam Hazard Rating	Type of Surveillance Inspection			
	Comprehensive Dam Safety Inspection (Formal Safety Inspection)	**Intermediate Dam Safety Inspection (Periodic Safety Inspection)**	**Routine Visual**	**Unusual/ Special/ Emergency**
Very High	On first filling then every 5-yearly	Annual	Daily[1]	Whenever necessary and when event occurs
High	On first filling then every 5-yearly	Annual	Daily to[1] Tri-Weekly	Whenever necessary and when event occurs
Significant	On first filling then every 7-yearly	Annual to 2-yearly	Twice Weekly to Weekly[1]	Whenever necessary and when event occurs
Low		On first filling then every 5-yearly	Monthly	Whenever necessary and when event occurs

***Malaysia Dam Safety Management Guideline (MyDAMS)**

Dam incident in Malaysia

Sultan Abu Bakar, Hydropower Dam (2013).





Dam incident in Malaysia

Sultan Abu Bakar, Hydropower Dam (2013).

Issues related to dam management

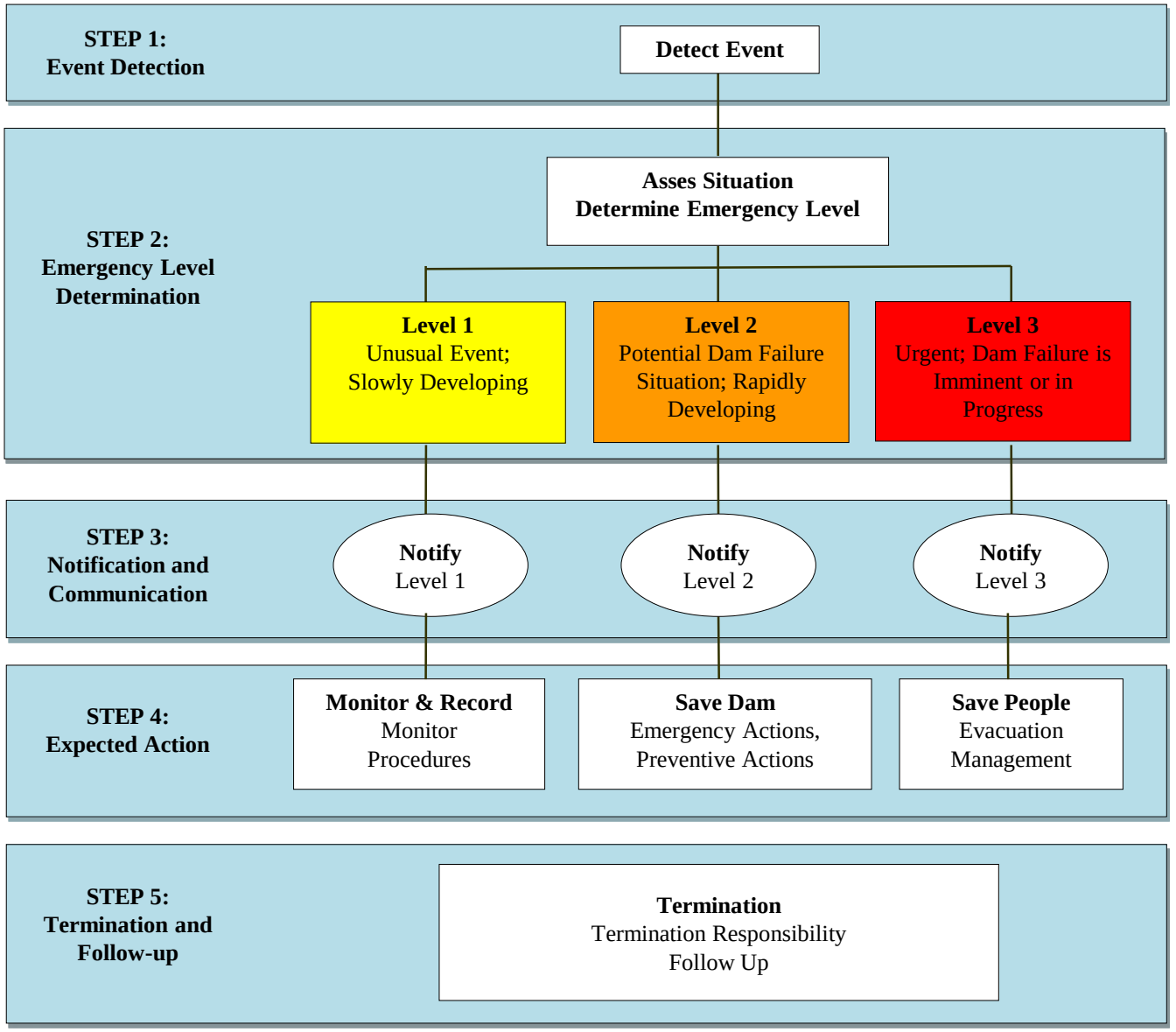
Issues Related To Dam Management

1. Importance of Dam Safety
2. Ownership
3. Dam Safety Management (DSM)
4. Legislation
5. Gazetting Catchment Area
6. Insufficient of Dam Technical Expertise
7. Enforcement

1. Importance of Dam Safety

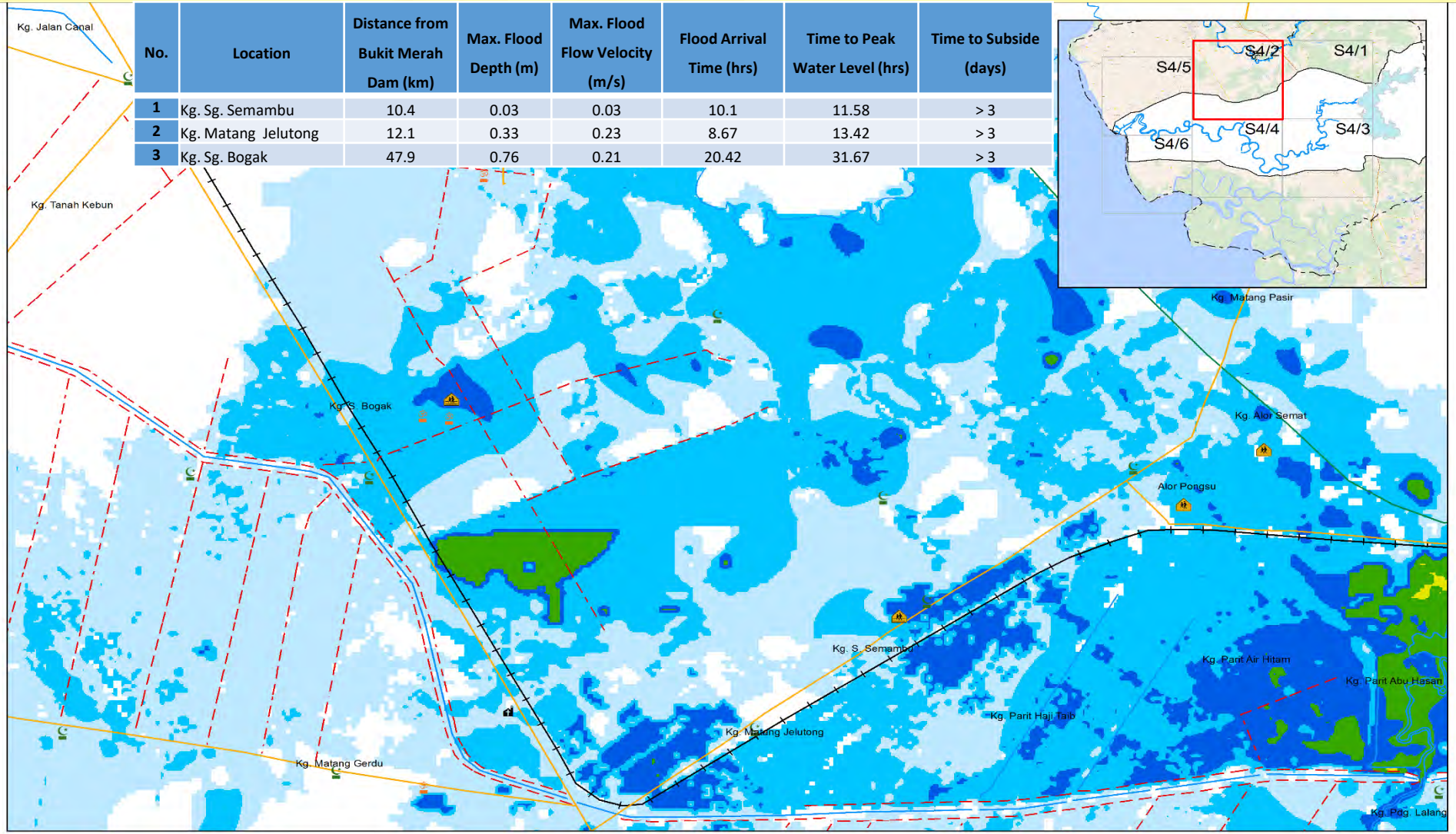
- Average dam exceed 40 year.
- Development of downstream area.
- DSM practices by self regulation (before MyDAMS introduced in 2017)
- Limited number of element of DSM.
- Emergency Action Plan (EAP) does not exist or inadequate.
- Surveillance inspector are not adequately qualified and trained.

EMERGENCY ACTION PLAN OVERVIEW



SCENARIO 4/2…(SAMPLE)

No.	Location	Distance from Bukit Merah Dam (km)	Max. Flood Depth (m)	Max. Flood Flow Velocity (m/s)	Flood Arrival Time (hrs)	Time to Peak Water Level (hrs)	Time to Subside (days)
1	Kg. Sg. Semambu	10.4	0.03	0.03	10.1	11.58	> 3
2	Kg. Matang Jelutong	12.1	0.33	0.23	8.67	13.42	> 3
3	Kg. Sg. Bogak	47.9	0.76	0.21	20.42	31.67	> 3



DEPARTMENT OF IRRIGATION AND DRAINAGE (DID) MALAYSIA

PREPARATION OF EMERGENCY ACTION PLAN FOR BUKIT MERAH DAM

FLOOD INUNDATION MAP FOR SCENARIO 4

MAP 17: FLOOD INUNDATION MAP FOR INFLOW DESIGN FLOOD OF PMF WITH DAM FAILURE (OVERTOPPING AND BREACH) AT DAM CREST LEVEL (S4/2)

LEGEND

Flood Inundation Depth (m)

0 - 0.5 | 0.6 - 1.2 | 1.3 - 2.0 | 2.1 - 3.0 | 3.1 - 4.0 | >4.0

Dam, Town, School, Mosque, Church, Temple, Highways, Main Road, Rural Road, Rail Road, River/Canal, Reservoir

N

1:65,000

0 0.5 1 2 3 km

Coordinate System: Kertau RSO Malaya Meters

1. Importace of Dam Safety

- Malaysia Inter-Departmental Committee(MIDC) was formed in 1986.
- Malaysia Dam Safety Management Guidelines (2017).

2. Dam Ownership

- Water supply is under the ownership of State Government.
- Hydroelectric dam owned by Tenaga National Berhad (Power Generator- Peninsular Malaysia), Sarawak Energy Berhad (Sarawak)
- JPS Dam through Federal Government allocation. Ownership?....Federal or State Government.

Need to be coordinated to ensure compliance with the policy and regulation.

2. Dam Ownership

Who's involved?

and many more…

3. Legislation

- Water and land fall under State Government jurisdiction.
- Law related to dam are under State Government.
- Federal Government to ensure the dam management is in line with International Best Practices.

A legal framework to be established to standardized surveillances and restoration of dams.

To ensure conformance to safety standards, the framework will address beyond the structure alone

Catchment Area	Reservoir	Dam structure	Downstream
			
Definition			
Area drained by the streams or water courses to the point at which the dam is located	Area of water body impounded	A barrier that impounds water or underground streams	Areas moving away from dam structure further towards the mouth of a river
Serious risk concern			
• Slope clearing affect velocity of water • High activity increase siltation at dam • Hazardous pollutant discharge	• Siltation decrease reservoir capacity to hold water and cause additional pressure on dam upstream scenarios • Water quality • Illegal dumping of garbage affect flow at intake and spillway • Water quality corrodes mechanical parts	• Cracks due to seismic • Lack of adequate early warning system • Reliability of mechanical parts	• Sufficient water passage route • Adequate early warning system

5. Gazetting of operation and basin area.

- Secure from encroachment or trespassing.
- To curb pollution and disturbances of catchment area.
- The law is under States Government.
- Prevent land being developed may incur loss of revenue for States Government.
- Protected Areas and Protected Places Act 1959
- National Key Point Central Committee Directive.

6. Lack of Dam Technical Expertise

- Surveillance task must be lead by accredited/qualified dam engineer.
- Shortage of trained worker to be placed full time at a dam.
- To ensure dam always in good condition
- Blue Ocean Strategy.
  - Flying Squad (under KATS)
  - 41 High Risk Dam (hazard rating)
  - Dam Technical Centre (DTC)

7. Enforcement

- Need to create a proper legislation and guidelines. (MyDAMS 2017 and Proposed Dam Safety Act)
- The responsibilities of the state and federal governments.
- The responsibility of dams owner/ dam operator and stakeholders

Government initiatives

CABINET DIRECTIVE (21 MAY 2014)

1. CONDUCT IMMEDIATE PROPER MAINTENANCE WORK FOR 41 DAM

2. PREPARE AN EMERGENCY RESPONSE PLAN (ERP/EAP)

5. ESTABLISH A SPECIAL COMMITTEE ON DAM SAFETY AT THE FEDERAL LEVEL

3. STRENGHTHEN THE CAPACITY OF TECHNICAL TEAM AND DAM OPERATOR

4. ESTABLISH DAM TECHNICAL CENTRE (DTC)

ACTION PLAN

1. Conduct immediate proper maintenance work for 41 dam (high risk)

Senarai Empangan Berisiko Tinggi(*High Hazard Potential Dam*)

No	Empangan	Negeri	Tahun Pembinaan	Pemilik	Operator
1	Juaseh	Johor	1992	Kerajaan Negeri Johor	Syarikat Air Johor Sdn. Bhd.
2	Bekok	Johor	1990	Jabatan Pengairan Saliran	Jabatan Pengairan Saliran
3	Sembrong	Johor	1984	Jabatan Pengairan Saliran	Jabatan Pengairan Saliran
4	Lebam	Johor	1979	Kerajaan Negeri Johor	Syarikat Air Johor Sdn. Bhd.
5	Gunung Ledang	Johor	1959	Kerajaan Negeri Johor	*Southern Water Corporation* (SWC)
6	Gunung Pulai 2	Johor	1940	Kerajaan Negeri Johor	Syarikat Air Johor Sdn. Bhd.
7	Gunung Pulai 3	Johor	1940	Kerajaan Negeri Johor	Syarikat Air Johor Sdn. Bhd.
8	Pontian Kecil	Johor	1940	Kerajaan Negeri Johor	Syarikat Air Johor Sdn. Bhd.
9	Beris	Kedah	2004	Jabatan Pengairan Saliran	Jabatan Pengairan Saliran
10	Ahning	Kedah	1989	Kerajaan Negeri Kedah	Lembaga kemajuan Pertanian Muda (MADA)
11	Malut	Kedah	1987	Syarikat Air Darul Aman Sdn. Bhd.	Taliworks

No	Empangan	Negeri	Tahun Pembinaan	Pemilik	Operator
12	Muda	Kedah	1969	Kementerian Pertanian dan Industri Asas Tani (MoA)	Lembaga kemajuan Pertanian Muda (MADA)
13	Pedu	Kedah	1969	Kementerian Pertanian dan Industri Asas Tani (MoA)	Lembaga kemajuan Pertanian Muda (MADA)
14	Pergau	Kelantan	1966	Tenaga Nasional Berhad (TNB)	Tenaga Nasional Berhad (TNB)
15	Bukit Kwong	Kelantan	1964	Jabatan Pengairan Saliran	Jabatan Pengairan Saliran
16	Bukit Kuda	Labuan	1985	Kerajaan Negeri Sabah	Jabatan Bekalan Air Labuan
17	Air Hitam	P. Pinang	1962	Kerajaan Negeri Pulau Pinang	Perbadanan Bekalan Air Pulau Pinang (PBAPP)
18	Perting	Pahang	2003	Jabatan Pengairan Saliran	Jabatan Pengairan Saliran
19	Sg Chereh	Pahang	2002	Kerajaan Negeri Pahang	Badan Kawal Selia Air Pahang (BKSAP)
20	Anak Endau	Pahang	1985	Jabatan Pengairan Saliran	Jabatan Pengairan Saliran
21	Sultan Abu Bakar	Pahang	1963	Tenaga Nasional Berhad (TNB)	Tenaga Nasional Berhad (TNB)

No	Empangan	Negeri	Tahun Pembinaan	Pemilik	Operator
22	Sultan Azlan Shah Sg Kinta	Perak	2006	Kerajaan Negeri Perak	Lembaga Air Perak (LAP)
23	Air Kuning	Perak	1991	Kerajaan Negeri Perak	Lembaga Air Perak (LAP)
24	Kenering	Perak	1984	Tenaga Nasional Berhad (TNB)	Tenaga Nasional Berhad (TNB)
25	Bersia	Perak	1983	Tenaga Nasional Berhad (TNB)	Tenaga Nasional Berhad (TNB)
26	Temengor	Perak	1977	Tenaga Nasional Berhad (TNB)	Tenaga Nasional Berhad (TNB)
27	Jor	Perak	1968	Tenaga Nasional Berhad (TNB)	Tenaga Nasional Berhad (TNB)
28	Mahang	Perak	1968	Tenaga Nasional Berhad (TNB)	Tenaga Nasional Berhad (TNB)
29	Chenderoh	Perak	1930	Tenaga Nasional Berhad (TNB)	Tenaga Nasional Berhad (TNB)
30	Bukit Merah	Perak	1906	Jabatan Pengairan Saliran	Jabatan Pengairan Saliran
31	Timah Tasoh	Perlis	1992	Jabatan Pengairan Saliran	Jabatan Pengairan Saliran
32	Babagon	Sabah	1997	Kerajaan Negeri Sabah	Jabatan Bekalan Air, Sabah

No	Empangan	Negeri	Tahun Pembinaan	Pemilik	Operator
33	Bakun	Sarawak	2012	Kementerian Kewangan	Sarawak Hidro Sdn. Bhd.
34	Batang Ai	Sarawak	1985	Sarawak Energy Berhad	Sarawak Energy Berhad
35	Sungai Selangor	Selangor	2001	Kerajaan Negeri Selangor	Syarikat Pengeluar Air Sungai Selangor Sdn. Bhd. (SPLASH)
36	Batu	Selangor	1987	Jabatan Pengairan Saliran	Jabatan Pengairan Saliran
37	Semenyih	Selangor	1985	Kerajaan Negeri Selangor	Konsortium Abass Sdn. Bhd.
38	Langat	Selangor	1979	Kerajaan Negeri Selangor	Puncak Niaga (M) Sdn. Bhd.
39	Klang Gates	Selangor	1959	Kerajaan Negeri Selangor	Puncak Niaga (M) Sdn. Bhd.
40	Tasik Subang	Selangor	1950	Kerajaan Negeri Selangor	Puncak Niaga (M) Sdn. Bhd.
41	Kenyir	Terengganu	1984	Tenaga Nasional Berhad (TNB)	Tenaga Nasional Berhad (TNB)

Collaboration between NRE and KETTHA (KATS) (Flying Squad)

ACTION PLAN

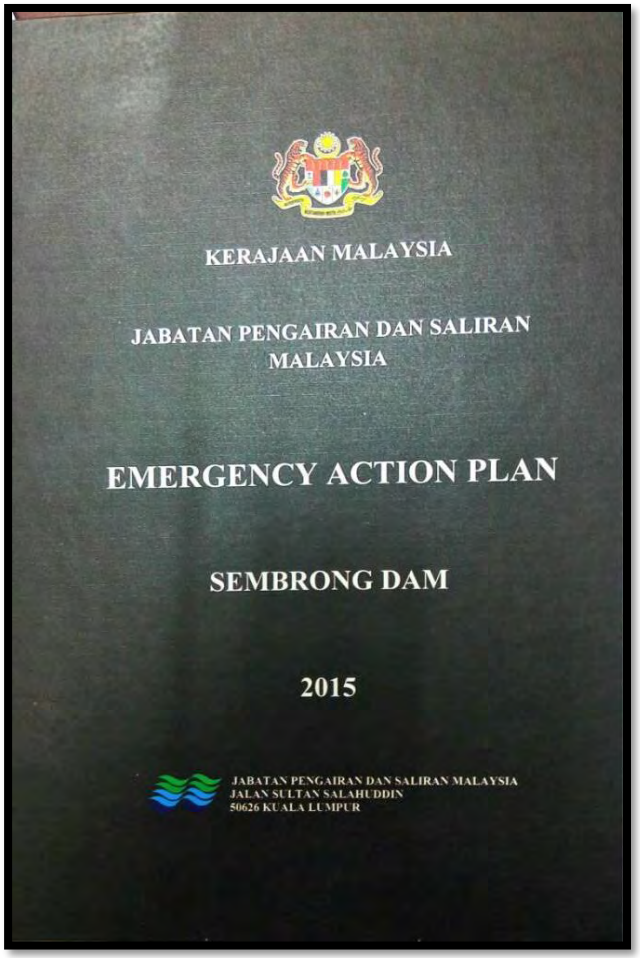
1. Conduct immediate proper maintenance work for 41 dam (high risk dam)

Flying Squad:-

1) National Blue Ocean Strategies (NBOS) – involved several technical agencies.
2) Use existing expertise from various ministries and agencies.
3) Conduct safety inspection at 41 high risk dam.
4) Generate dam safety report on an annual basis.

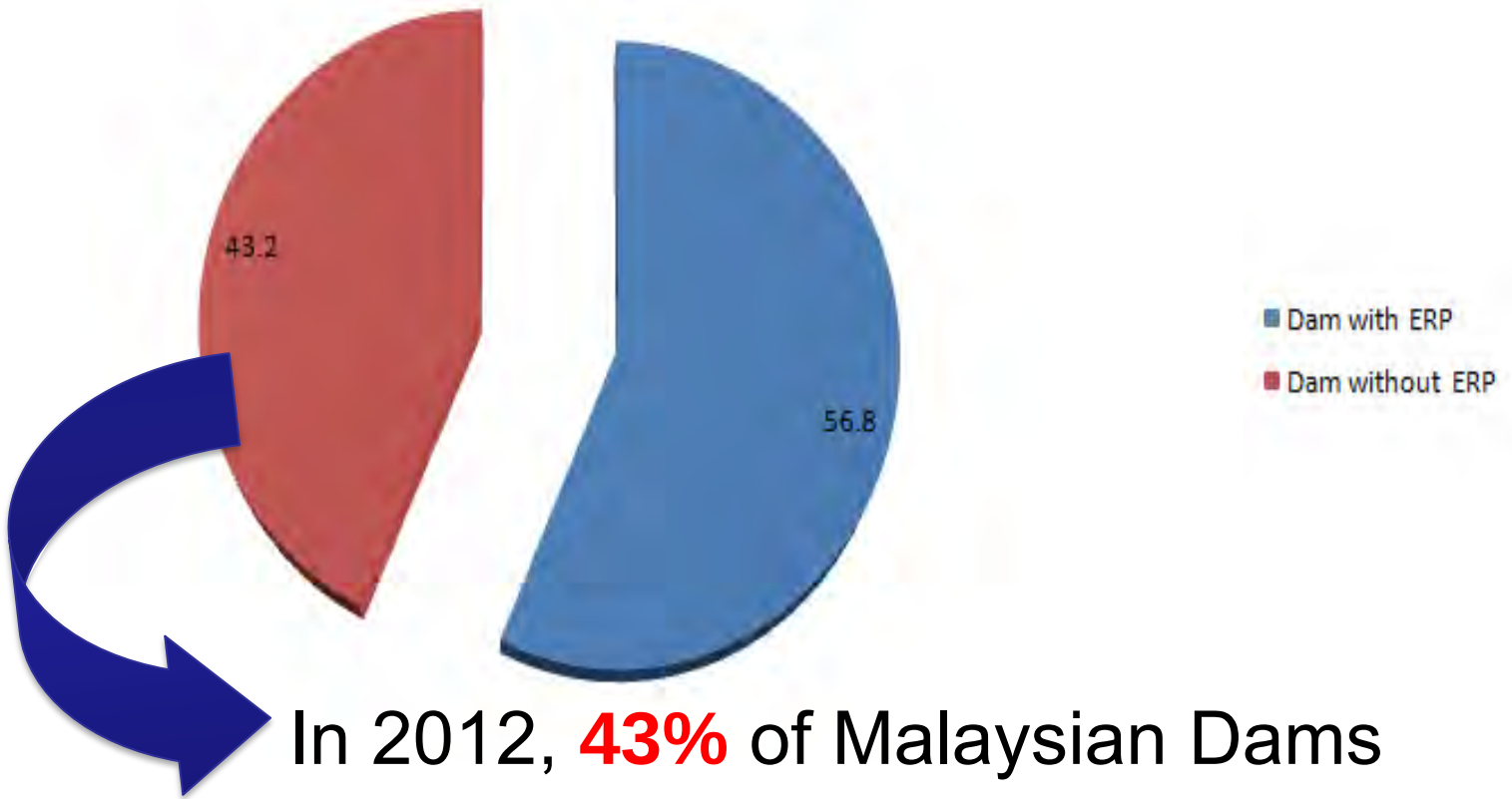
ACTION PLAN

2. Prepare an Emergency Response Plan (EAP/ERP)



ACTION PLAN

2. Prepare an Emergency Response Plan (EAP/ERP)



In 2012, **43%** of Malaysian Dams **do not have** a well maintained **ERP.**

ACTION PLAN

3. Strenghten the Capacity Of Technical Team and Dam Operator

Scope of Work

- Operation
- Routine surveillance
  - Inspection, Monitoring and Reporting
- Minor maintenance works
- Implementation of ERP
  - drill, modify, updating
- Gazettement and ownership
- Secure any required development budget
- Other works stipulated in the O&M manual

ACTION PLAN

4.0 Establish Dam Technical Centre (DTC)

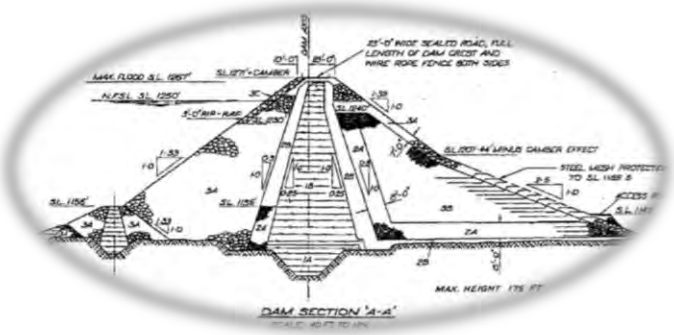
i. Initial proposal - led by KETTHA

ii. Integrated implementation of surveillance work by federal agencies.

iii. Database of dam inventories and surveillance information.

iv. Assist dams operator in terms of technical advices and expertise.

v. Currently led by Flying Squad (KATS)



ACTION PLAN

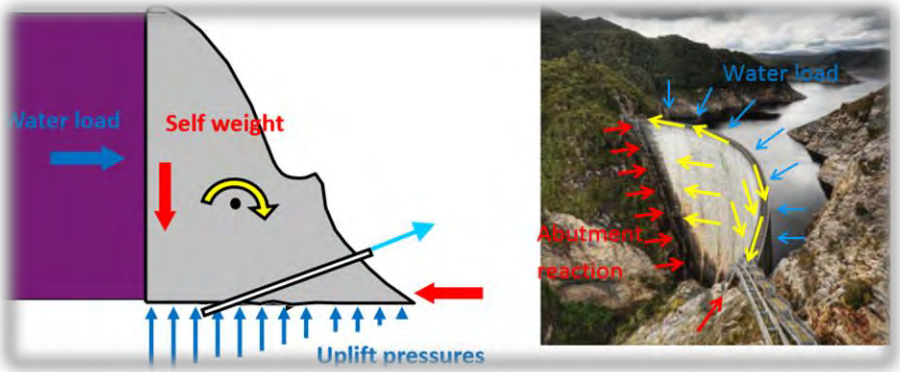
4.0 Establish Dam Technical Centre (DTC)

1. Periodic safety inspection (Annually).
2. Formal safety inspection (5-yearly).
3. Emergency safety inspection.
4. Special safety inspection.
5. Review dam operator's routine surveillance report.
6. Monthly monitoring/evaluation of instrumentation data.
7. Prepare design solutions for problems identified in safety surveillance.
8. Secure Development budget.
9. Decommissioning.

Government Initiatives

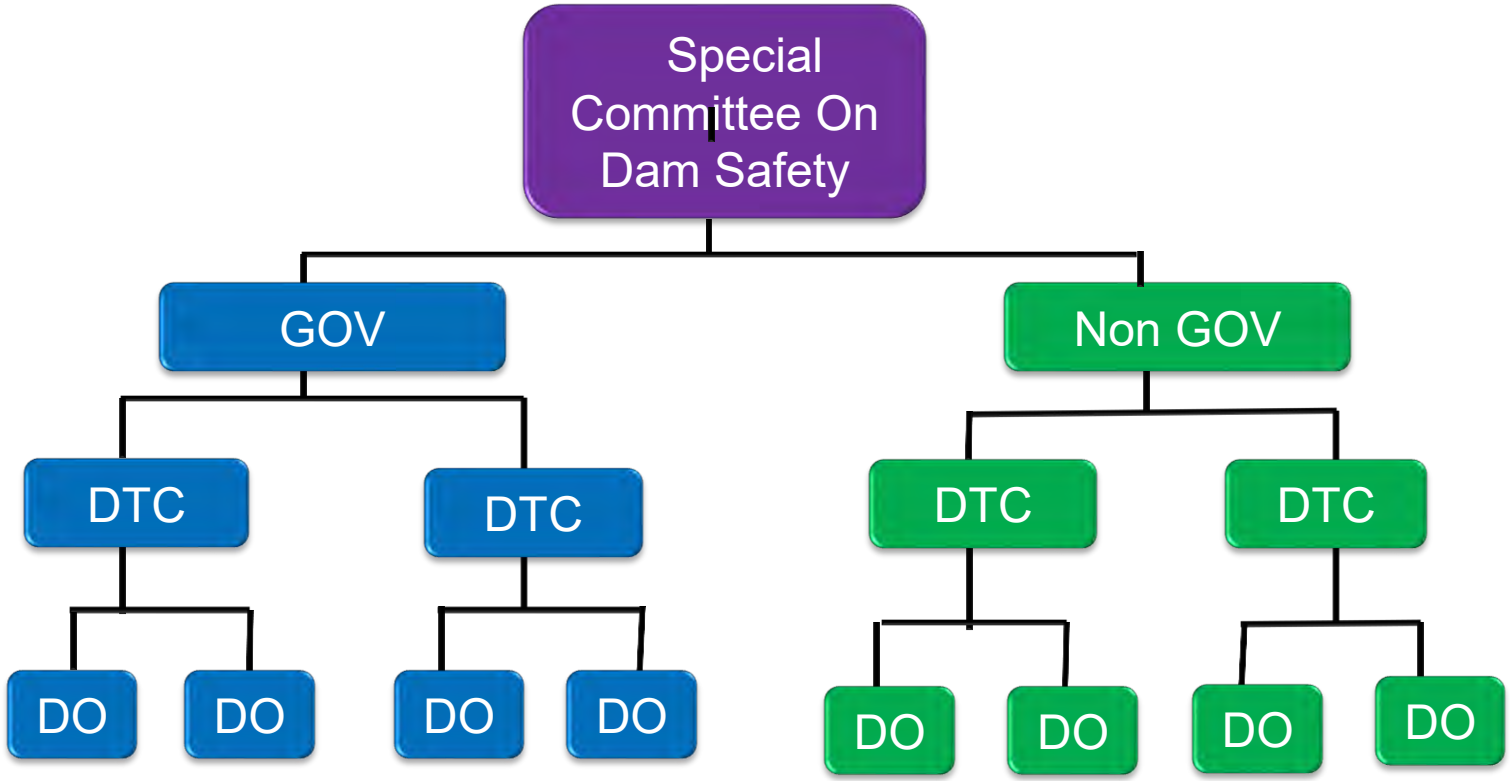
5.0 Establishment of Special Committee on Dam Safety at Federal Level

- Led by the Ministry of Water, Land and Natural Resources (KATS) to regulate the management of dams in Malaysia.
- To ensure that the dam management standard are complied with MyDAMS.



ACTION PLAN

5.0 Special Committee on Dam Safety at Federal Level



ACTION PLAN

5.0 Special Committee on Dam Safety at Federal Level

- National Dam Safety Management Guidelines
  - **(MyDAMS)**

- Draft of National Dam Safety Management Act (NDSMA)
  – ***currently being drafted***

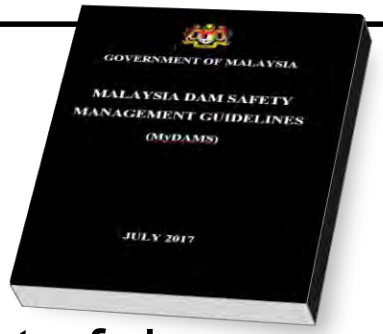
Government Initiatives

MyDAMS

Objectives:

- To manage dams in Malaysia in a systematic and sustainable manner.
- To ensure uniform dam safety management practices according to acceptable standards.

Government Initiatives



MyDAMS

- Provides a framework for the management of dam safety and guidelines for development and implementation of dam safety practices throughout Malaysia.

- Outlines guidelines on dam safety practices that should be considered during the investigation, design, construction, commissioning, maintenance, operation, safety surveillance, safety review, emergency preparedness and lifecycle management of dams in Malaysia.

Government Initiatives

MyDAMS

- These guidelines reflect current international dam safety management practices.
- It complements Malaysia key environmental and safety legislations applicable on dams.
- It assists dam owners and operators, government authorities, consultants and contractors in establishing good dam safety practices.
- It complements the Dam Safety Act currently being drafted.

Conclusion:

- The current dam safety management practices is progressively toward in line with good international practice.
- Need to reduce the common cases of non-conformances of local DSMS by strengthening technical capacity among dam owner and dam operator.
- To reduce dam owner/operator which are not in line with good international practice.
- The model Law of Dam Safety Act will improve any deficiencies in the dam safety management system of dam owner.
- A real need to establish a government body (federal or/and states level) to regulate development and operation of dams.
- MyDAMS to assist dam owner and all parties in understanding the legal obligation and liabilities of those associated with the development, ownership and operation of dams in Malaysia.

Anyway ...

Who says Dams are RISKY?

Thank you

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