Australian Government

Australian Nuclear Science and Technology Organisation

Little Forest Burial Ground Scenario

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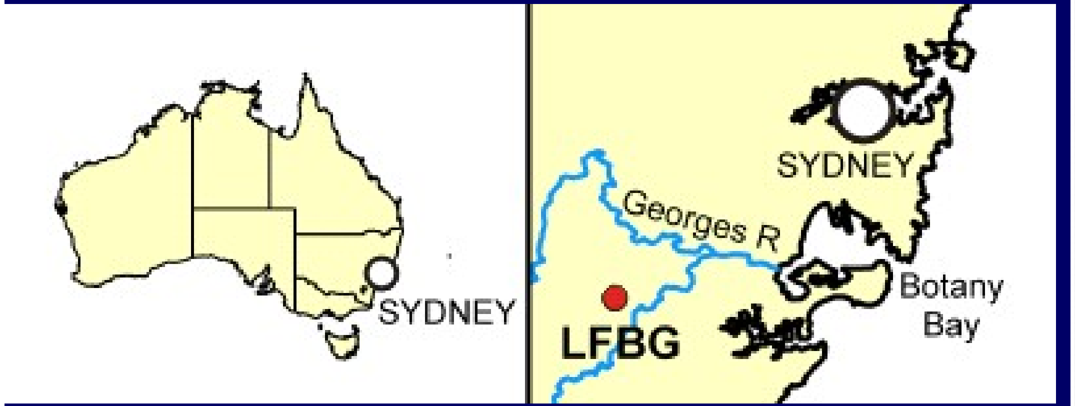
Little Forest Burial Ground Scenario Background

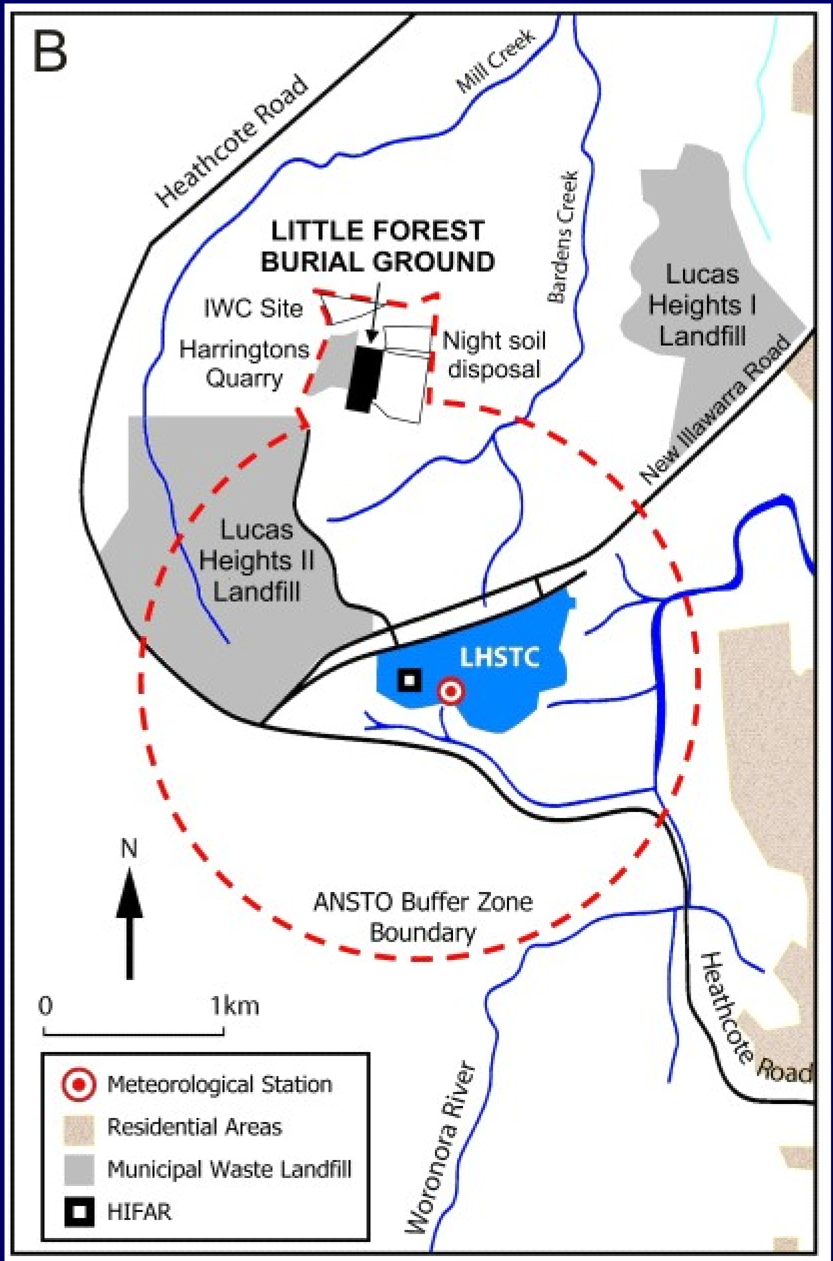
- Raised as a concept in Jan 2009 EMRAS-II
- Initial presentation given & feedback received July
- For model comparison study, LFBG has plusses:
  - + Terrestrial site - compliments Beaverlodge aquatic site
  - + Good range of species (plants, arthropods, reptile, bird, mammals)
  - + Good range of rads (transuranics, gamma emitters, beta emitters)
  - + Straightforward – good for model comparison

  and minuses:
  - - Low rad concentrations
  - - Small site
  - - Sparse tissue data - (have grass & TLD γ data, expect some insect data ~4 months, potential for TLD β & some mammal data). This focuses the exercise on <u>model-to-model comparison</u> rather than model-to-site comparison
- ANSTO & ARPANSA are keen

Site Location

- Located near Sydney, New South Wales, Australia.





Site Location

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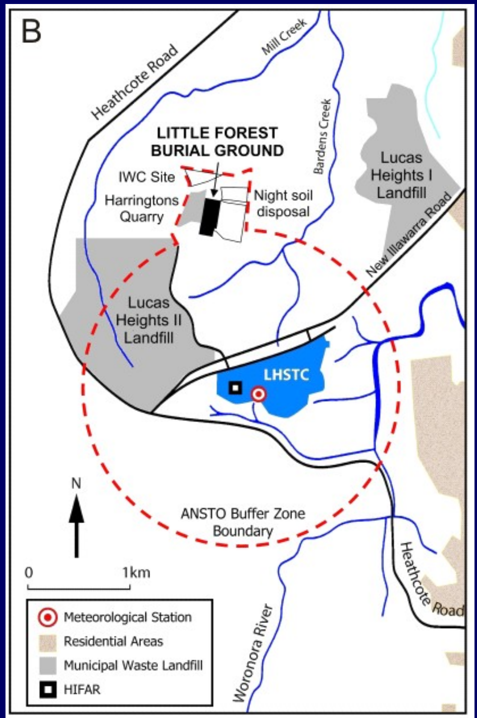
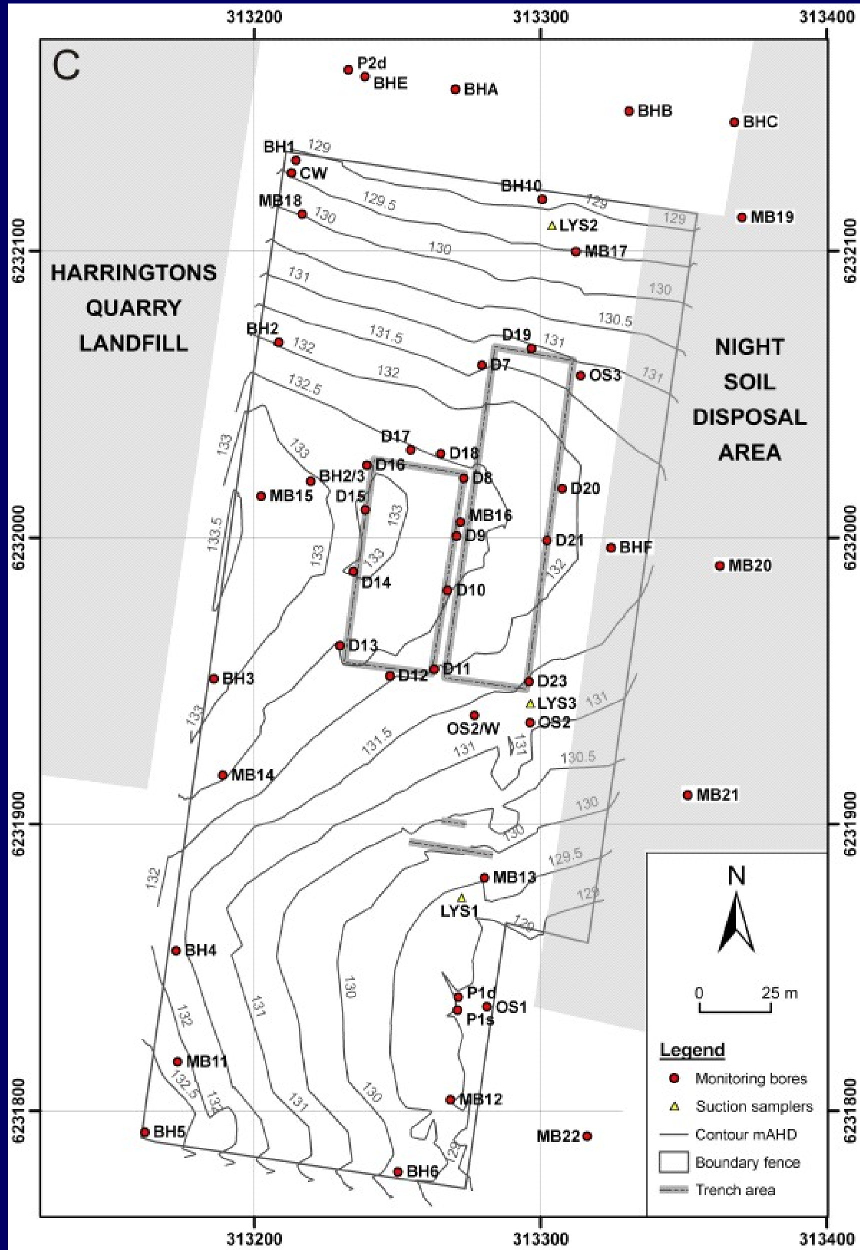
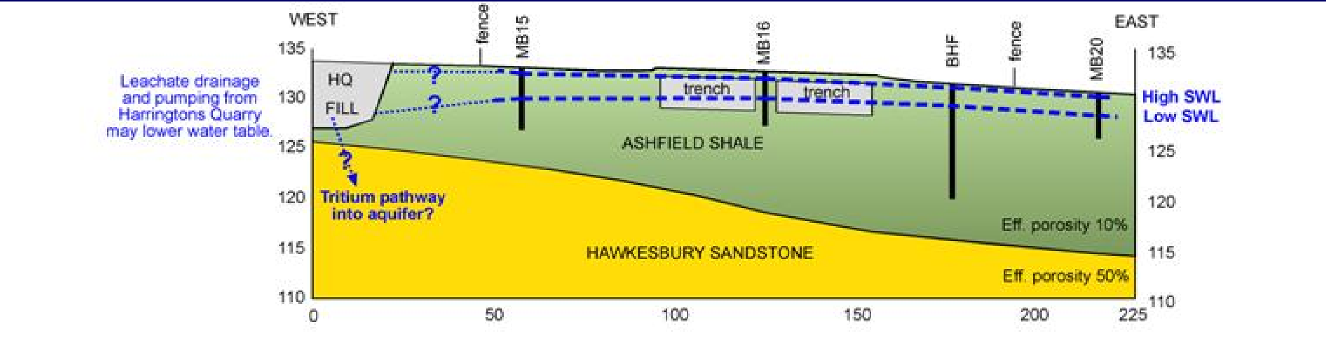
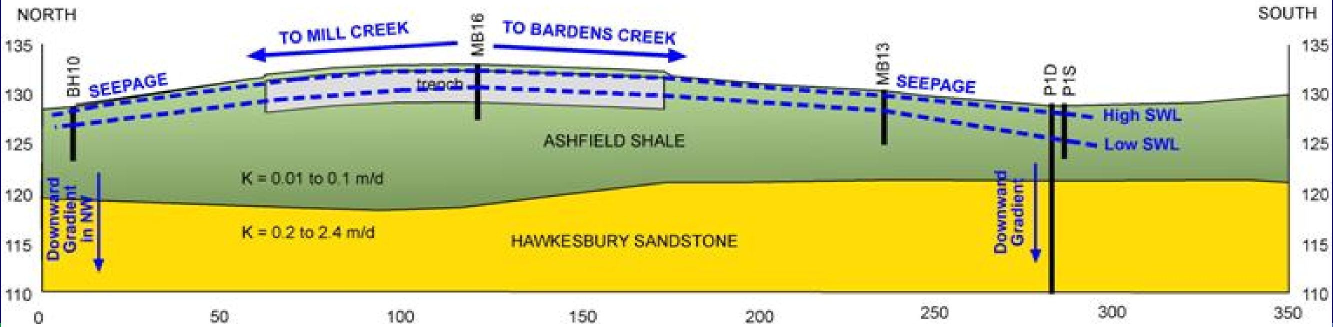




Climate and Hydrology

- Ave annual rainfall -1013 mm, annual evaporation ~1600mm, maximum and minimum temperature between 25.9˚C and 7.1˚C (daily averages).
- Shallow groundwater occurrence is intermittent. During wet periods, the table is ~1-3m depth and therefore fluctuates over time within the trenches. Groundwater flow is relatively slow in clay-dominated soils and flows radially outward (in multiple directions) away from the trench area.





Waste Disposal

- Waste disposed in 1960-68.
- Waste was from reactor, medical, other academic research.
- 79 trenches extending from ~0.5 to ~3.0m below the ground surface.
- ~150 GBq of radionuclides, including many short-lived isotopes as well as H-3, Co-60, Sr-90, Cs-137, Th-232, U-233, -235, -238, Pu-238/240, Am-241 among others
- various forms and types of packaging.

1960-68 Disposal at LFBG

Site after disposal

• In 1983, ~30 cm of topsoil was placed over trenches.

Current state

•Grass-dominated vegetation cover,

•Bordered by low forest & scrub representative of original vegetation.

•Site is maintained with fencing, signage, grass mowing, and regular monitoring.

Biological dose modelling

- Objectives:
  - Compare estimates of tissue concentrations
  - Compare estimates of doses
  - Focus on CR estimation for a range of plants and animals
  - Focus on probabilistic model capabilities

- 10 site-specific species (3 plants, 7 animals) –physio data provided
- Consider "realistic worst case" member of local population
- Occupancy factor assumptions are provided - based on site surveys
- Current rad concentration data in soil are provided

- Output results will emphasize model-to-model comparison, with limited site tissue data available:
  - Vegetation (grass) data
  - TLD γ data at 1m, ground surface, 10cm depth
  - Expect Pu & Am results for insects ~3months
  - no bird/mammal tissue data is currently available

Ten Representative Species

Plant – Grass

Plant, tree – Acacia

Plant, root crop – Yam

Annelid – Earthworm

Arthropods - Insects (beetle, grasshopper)

Reptile – goanna

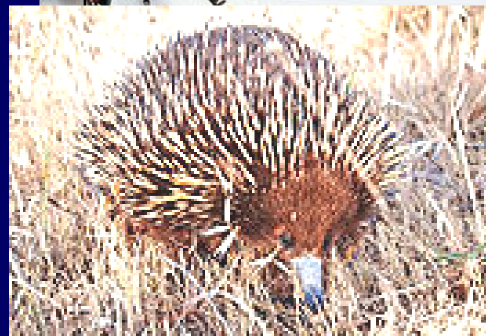
Bird - raven (representing raven, magpie, kookaburra)

Mammal, monotreme – Echidna

Mammal, placental, canine – Fox

Mammal, marsupial, macropod – Wallaby



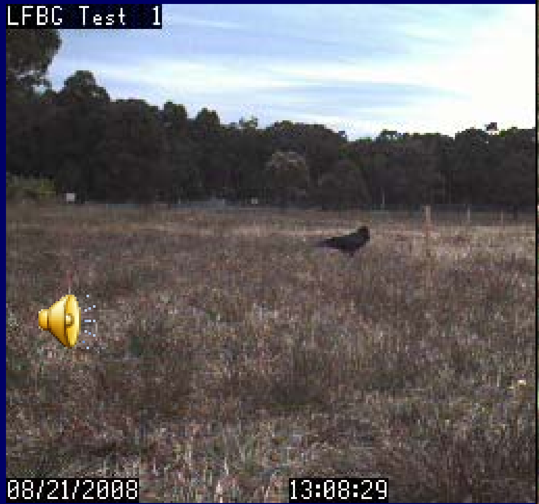



Representative Species Data

		Weight (kg)	Dimension of head and body a,b,c (cm)	Notes/assumptions
graminoids	Grass	0.01	20, 1, 1	0-10cm root depth
Vigna lanceolata	Pencil yam	0.1	15, 3, 3	Assume <1 m yam root depth
Acacia	Acacia	845	1500, 25, 25	Assume 0-2m root depth
Octochaetidae	Earthworm	0.0052	10, 1, 1	Lives 0-1m deep in soil. Eats organic matter w/soil ingestion
Insecta	Insects (beetle, grasshopper)	0.001	1, 0.4, 0.2	This category of insect lives 100% at soil surface. Eats organic matter, scavenger
Varanus varius	Goanna	8	70, 16, 12	Lives 80% at soil surface, 20% in tree. Eats insects, eggs, smaller reptiles, carrion.
Corvus coronoides	Raven	0.6	40, 14, 10	Lives 70% in tree/air, 30% at soil surface. Eats 34% carrion, 42% invertebrates, 24% plant s
Tachyglossus	Echidna	4	40, 20, 15	Lives 60% in soil, 40% at soil surface. Eats invertebrates (ants) high dust inhalation
Vulpes vulpes	Fox	8	68, 18, 14	Lives 60% in soil, 40% at soil surface. Eats invertebrates, berries, grasses, carrion, rabbits, wallaby
Wallabia bicolor	Swamp wallaby	14	75, 30, 22	Lives 100% at soil surface. Eats grass, forbs.

Additional Information: Goanna

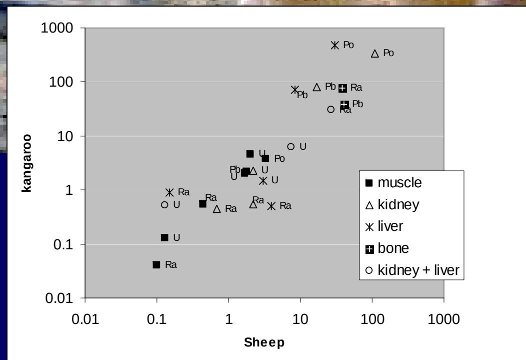
Additional Information: Raven



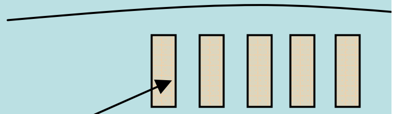
Additional Information: Echidna

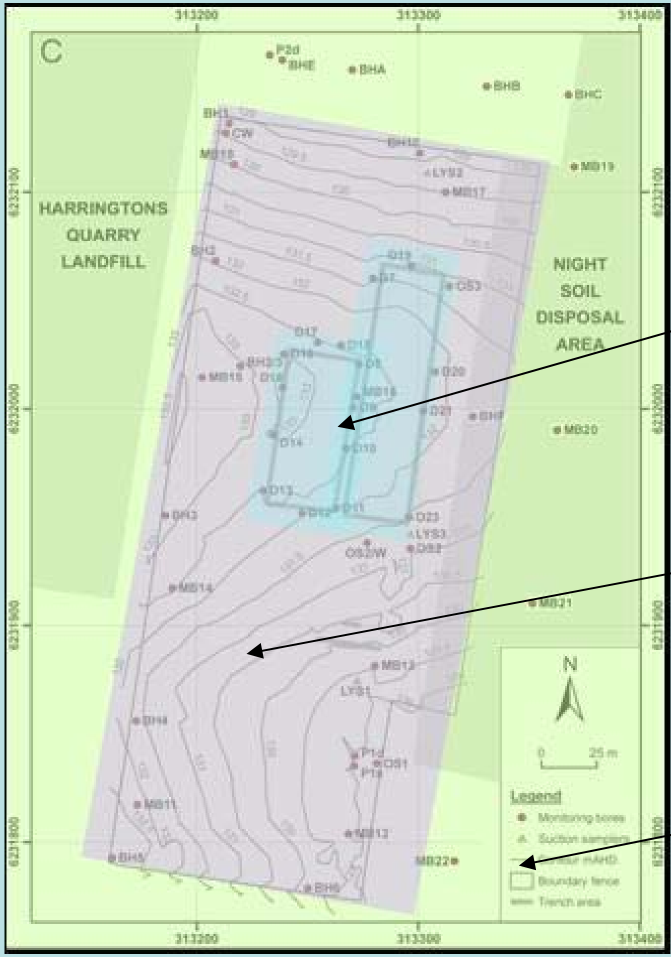
Additional Information: Fox

Additional Species Information: Wallaby



Assumed Contaminant Exposure Zones





•Zone 1 – Beneath-ground, within waste material (within original trenches)

•Zone 2 – Ground surface, and beneath-ground (soil), within 4m of trenches

•Zone 3 –All other area within site boundary

Occupancy Factors

“Reasonable Worst Case” member of the local species population

	Zone 1	Zone 2	Zone 3	Other areas
Grass		100%		
Acacia	50%	50%		
Yam			100%	
Earthworm	10%	90%		
Insects		100%		
Goanna		10%	20%	70%
Raven		30%		70%
Echidna		10%	20%	70%
Fox		10%	20%	70%
Wallaby		30%	20%	50%

Soil Concentrations – Current conditions

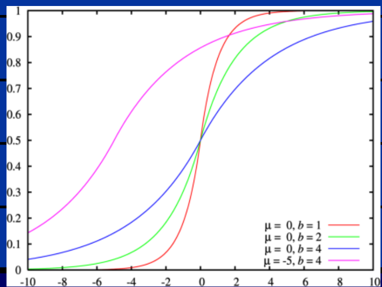
	Zone 1	Zone 2	Zone 3
	ave, max, min, stdv	ave, max, min, stdv	ave, max, min, stdv
Co-60	2211, 4000, 108, 1330	2, 10, 0.6, 2	1,2, 0.5, 0.6
Sr-90	1000, 1500, 500, 500	28, 207, 3, 43	4, 5, 3, 0.7
Cs-137	472, 1000, 171, 315	3, 9, 1, 2	2, 3, 1, 0.3
Th-232	500, 650, 250, 200	54, 68, 43, 8	12,16, 8, 4
U-233, 234	475, 938, 49, 200	47, 87, 34, 15	7, 8.0, 6, 1
U-238	400, 600, 300, 300	38, 49, 30, 4	4, 5, 3, 0.7
Pu-238/39/40	4220, 1.1E5, 439, 2000	3, 16, 0.1, 5.4	0.01, 0.02, 0, 0.01
Am-241	710, 1290, 130, 820	4, 24, 0.3, 8	0.01, 0.02, 0, 0.01

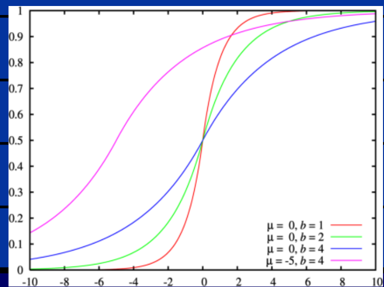
No highlight indicates information was derived from observed data.
Dark highlight indicates the information was derived by extrapolating from observed data.
Light highlight indicates the information is hypothetical.

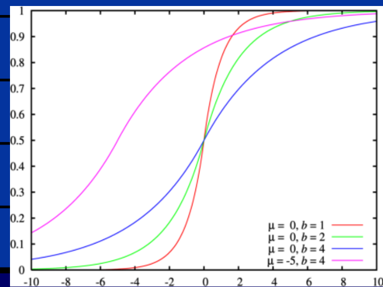
Reporting

A spreadsheet will be provided that will include:

	CR assumption	Tissue concentration est. (Bq/Kg)	Dose est. (Gy/d)
Grass			
Pencil yam			
Acacia			
Earthworm			
Insects (beetle, grasshopper)			
Goanna			
Raven			
Echidna			
Fox			
Swamp wallaby			







Would like to compare cumulative distribution functions for CR, Tissue Conc., and dose

Schedule

- discuss


LFBG transect inverts
05/26/2009


BUCKEYE CAM
LFBG Oct 2009, On trenches
12/17/2009
22:40:00
Lapse Trigger

LFBG Test 1
08/19/2008
11:40:48