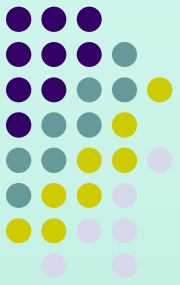


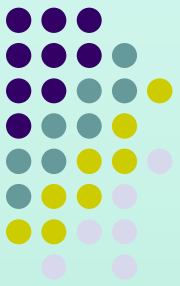
Managing the Acoustic Learning Environment



Current South Australian research project that identifies factors that produce effective acoustic upgrades 2011

***Chris Channing – Eastern Adelaide Region
Virginia Adare – Barossa Region***



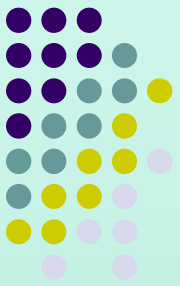


Presentation Content

- **Hearing Services Coordinator's role**
- **The Acoustic Journey**
- **The Process**
- **Procedures and Protocols**
- **The Research**
- **Pre/Post upgrade research data**
- **Summary**
- **Recommendations**



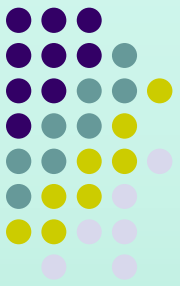
The role of the Hearing Services Coordinator (HSC)



- Based in regional offices (metro/country) part of a multi-disciplinary team.
- Consultative role in partnership with school personnel/families.
 - Provide advice about verification of learners who are Deaf or hearing impaired.
 - Provide information about educational options.
 - Facilitate and manage Levels of Support.
 - Provide support around curriculum and program planning, interventions and accommodations through the Negotiated Education process.
 - Support management of acoustic modifications and assistive listening devices.
 - Facilitate and deliver professional development.



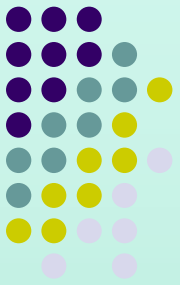
The Acoustic Journey



- In 2002, through the Disability Discrimination Act (DDA), optimal listening environments were acknowledged as significant for access to the curriculum for learners with hearing impairment. As a result, an Acoustic Reference Group was formed and an Acoustic Policy developed and embedded in DECS' Asset Policy.
- The Policy was compiled from the Australian/New Zealand Standard 2107:2000 for sound levels and reverberation times for building interiors. The Policy has been in place for the last 10 years.



The Acoustic Journey



From the Policy :

The development of acoustic pathways for learners who are Deaf or hearing impaired in schools.

Collaborative partnership between Asset Support Centre of DECS and the Hearing Services Field.

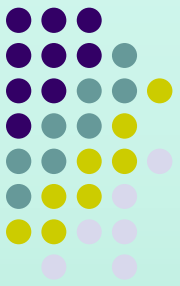
All new relocatable buildings must be fitted with ceiling acoustic material.

Classroom acoustics linked to Soundfield technology.

Acoustic modifications reviewed by HSC through post upgrade audits and surveys to identify acoustic benefits.



Acoustic Standard Adopted by DECS



THE STANDARD

- *Unoccupied acoustic standards in classroom/spaces (pre-school through to secondary facilities) in South Australian schools Promoted by DECS in line with AS/NZS 2107:2000*

NOISE

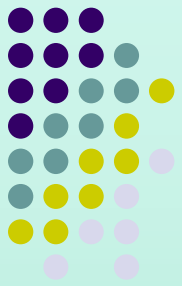
- **Unoccupied noise levels in classroom/spaces in preschools and schools are:
35- 45dBA in Pre-school Listening Areas, Junior Primary, Primary and Secondary Classroom Spaces.**

REVERBERATION

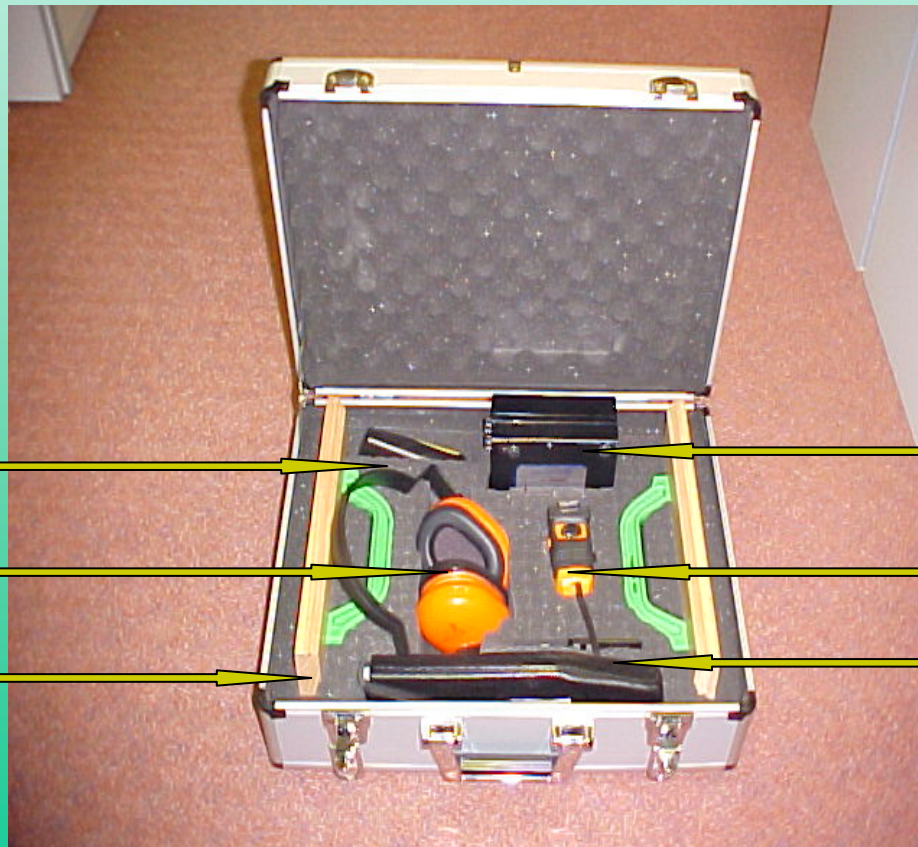
- **Pre-school listening areas 0.4 – 0.5 seconds**
- **Primary Classrooms 0.4 – 0.5 seconds**
- **Secondary Classrooms 0.5 – 0.6 seconds**



Process for Learning Space Acoustic Measurements



Audits undertaken using electronic acoustic kit – each Regional Office is provided with a kit. Instruments are calibrated yearly to ensure validity.



Electronic measurer

Ear Protector

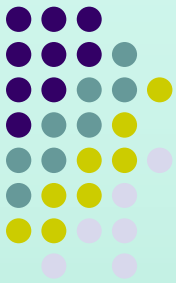
Clappers (Impact noise maker)

Reverberation Meter

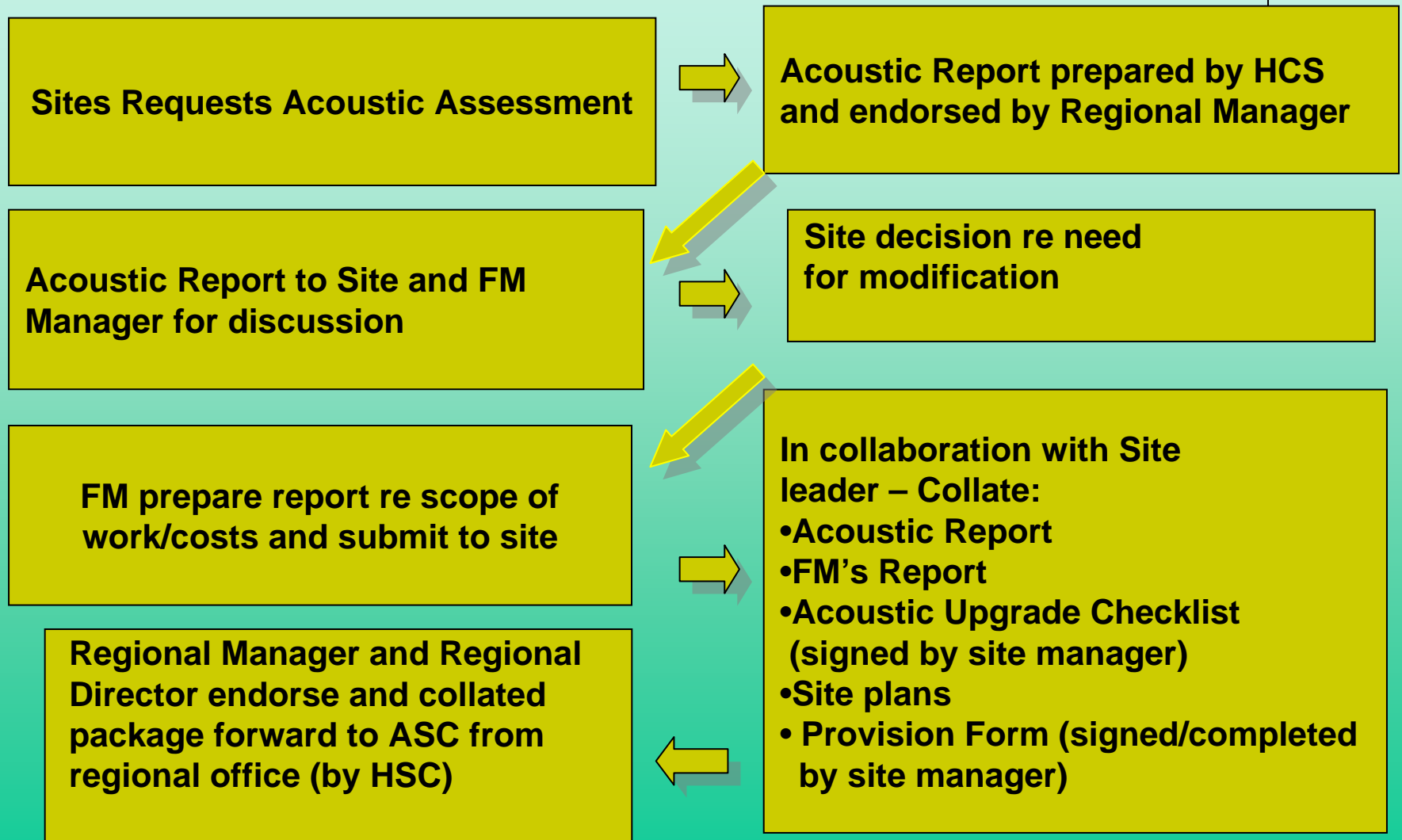
Tape Measure

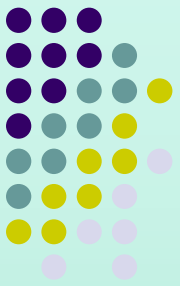
Sound Level Meter





Process for Learning Space Acoustic Measurements





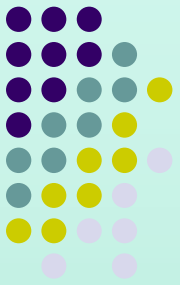
The Research

Analysis of the comparative data – changes to sound levels and reverberation times in acoustically upgraded learning spaces for learners with hearing impairment from 2006 – 2010 for primary and secondary learning spaces.





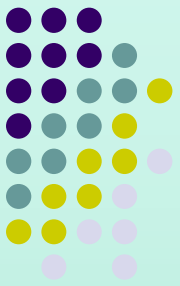
Procedures & Protocols



This project has five aims:-

- To provide data on the acoustic advantage delivered by an upgrade to a learning space. The data was a collation of noise and reverberation measurements pre and post upgrade in the unoccupied learning space.
- Analyse if acoustic upgrades make a significant difference in reverberation time and noise.
- To identify the sound absorption properties of materials that were most effective in delivering an acoustic advantage.
- To identify the most effective placement/modification of acoustic products in a range of learning spaces that will deliver a reduction in reverberation time.
- Assisting Departmental Officers and Hearing Services Coordinators in planning improved access for students with hearing impairment.

Procedures & Protocols

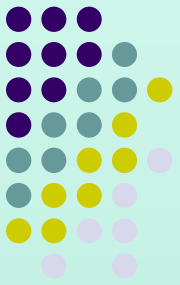


The Process

- **Survey proforma distributed to HSCs statewide.**
- **Survey involved collection of noise/reverberation measurements in unoccupied learning spaces pre and post upgrade for the preceding 4 years.**
- **Products used and application.**
- **The response for the survey was 90%.**



Procedures & Protocols



- **Data samples represented a range of learning spaces e.g. open space, single and double classrooms.**
- **Construction of buildings included metal/wooden transportables, brick/stone (heritage) and mixtures of the above materials.**
- **The survey requested information about:-**
 - 1) Noise levels pre/post retro fitting of new air-conditioners.**
 - 2) Reverberation levels pre/post acoustic upgrade to ceilings and walls.**
 - 3) Noise Reduction Coefficient (NRC) measurement of products used.**

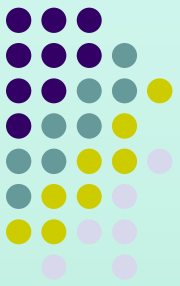




Government of South Australia
Department of Education and
Children's Services



Procedures & Protocols



- **The 36 learning spaces were grouped by volume into categories :-**

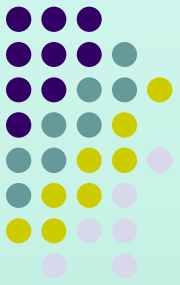
Standard Rooms (**< 190m³**)

Large Rooms (**191-249m³**)

Extra-Large Rooms (**250m³>**)



Procedures & Protocols



Noise

- In this survey the variable for learning space noise targeted air-conditioner noise only (unoccupied).

Reverberation

- Data collected was categorised, analysed, averaged and graphed from the pre/ post survey information. Data included description of the learning area, building type, volume and pre and post existing treatments.

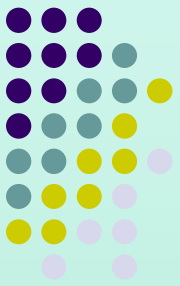
Protocols

These protocols were used and applied in this research with all learning spaces.

- Position P1 (centre of room for noise and reverberation readings)
- Condition – unoccupied (no students present)
- Conversion to unoccupied using Boothroyd methodology
- Reverberation meter sensitivity – 15
- 90 dBA impact noise across octave intervals 250hz, 500hz, 1000hz, 2000hz and 4000hz to measure RT
- Air-conditioner measured using same conditions as pre upgrade



THE RESULTS

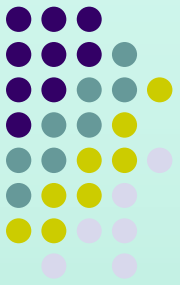


NOISE

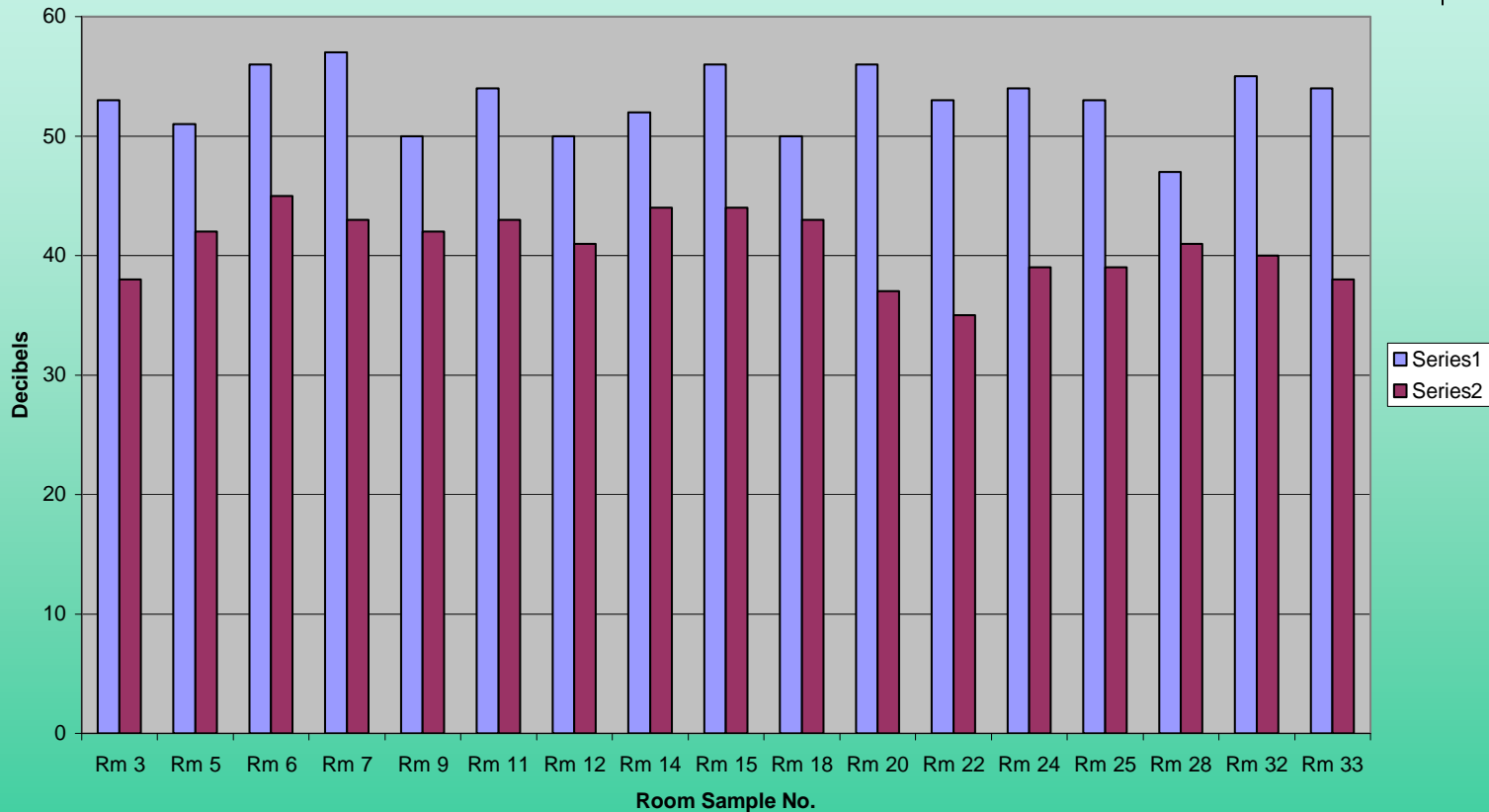
- In South Australia many learning spaces have older conventional air conditioners that are not thermostatically controlled. Most were window mounted.
- 17 learning spaces were fitted with new quiet air conditioners that were wall/ceiling mounted.



Pre/Post Noise Upgrade



Noise Pre-Post Airconditioner Upgrade



These 17 learning spaces had conventional air-conditioners replaced with split level systems reducing noise level by 13 decibels.



Pre/Post Noise Upgrade



FINDINGS

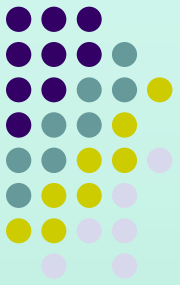
- The replacement of older air conditioning systems in all 17 classrooms (Extra Large, Large and Standard in volume) produced a significant reduction in noise. The average reduction was 13 dBA.

DISCUSSION

- All systems were split level - wall or ceiling mounted.
- The average reduction in noise output increases the signal to noise ratio and improves the listening environment.
- The reduction of 13dBA can make a significant difference to teaching processes and the learning access to instruction.
- The replacement of older air conditioning systems brought the noise levels within the Australian recommended standard.



THE RESULTS



REVERBERATION

- 34 Learning spaces received acoustic upgrades (treatment) to walls and walls/ceiling

Treatments:

Lowered ceilings and walls (1/3)

Ceilings and walls (1/3 and 1/2)

Ceilings (total)

Walls (full walls and 1/3 walls only)

Products:

Glass wool

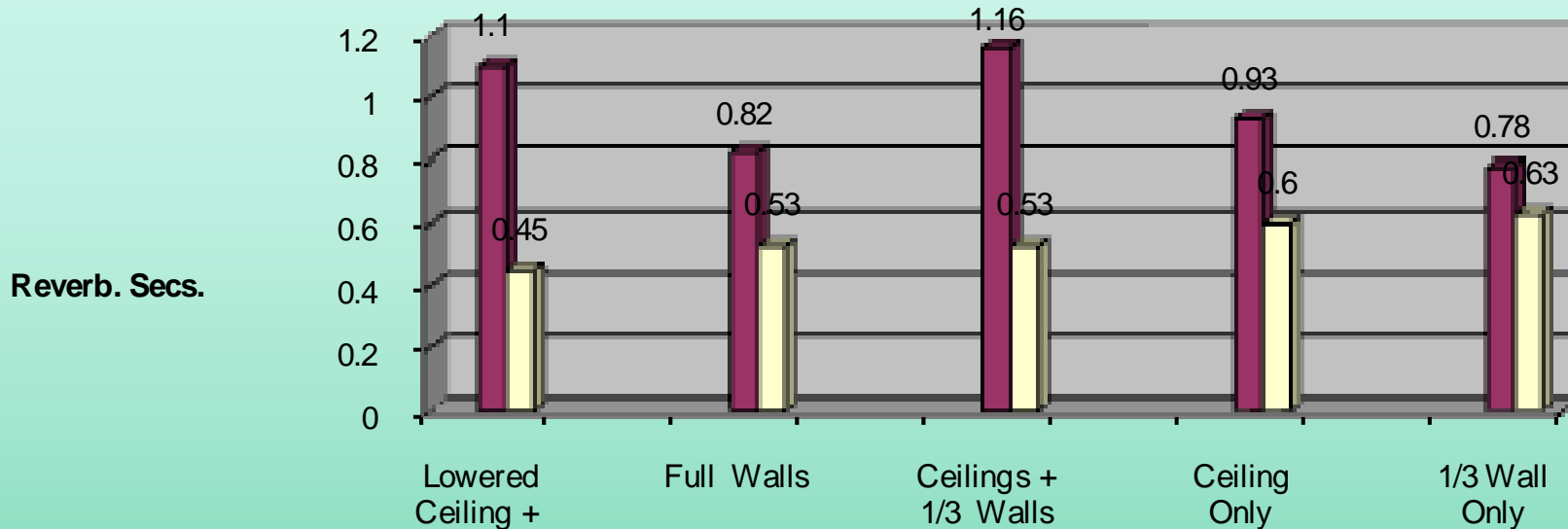
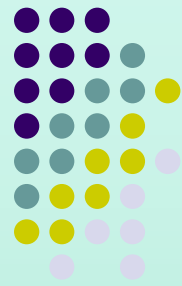
Mineral Fibre Tiles

Acoustic Ceiling Tiles

Acoustic Polyester Wall Fabric and Panels (25 and 50 mm)



REVERBERATION – Pre/Post Standard Rooms



FINDINGS

Lowered ceiling + 1/3 wall treatment produced an RT average reduction of 0.65 seconds

Full wall treatment produced an average RT reduction of 0.29 secs.

Acoustic ceiling and 1/3 wall treatment produced an RT average reduction of 0.63 secs.

Ceiling only treatment produced an average RT reduction of 0.33 secs.

1/3 wall treatment only produced an average RT reduction of 0.15 secs.

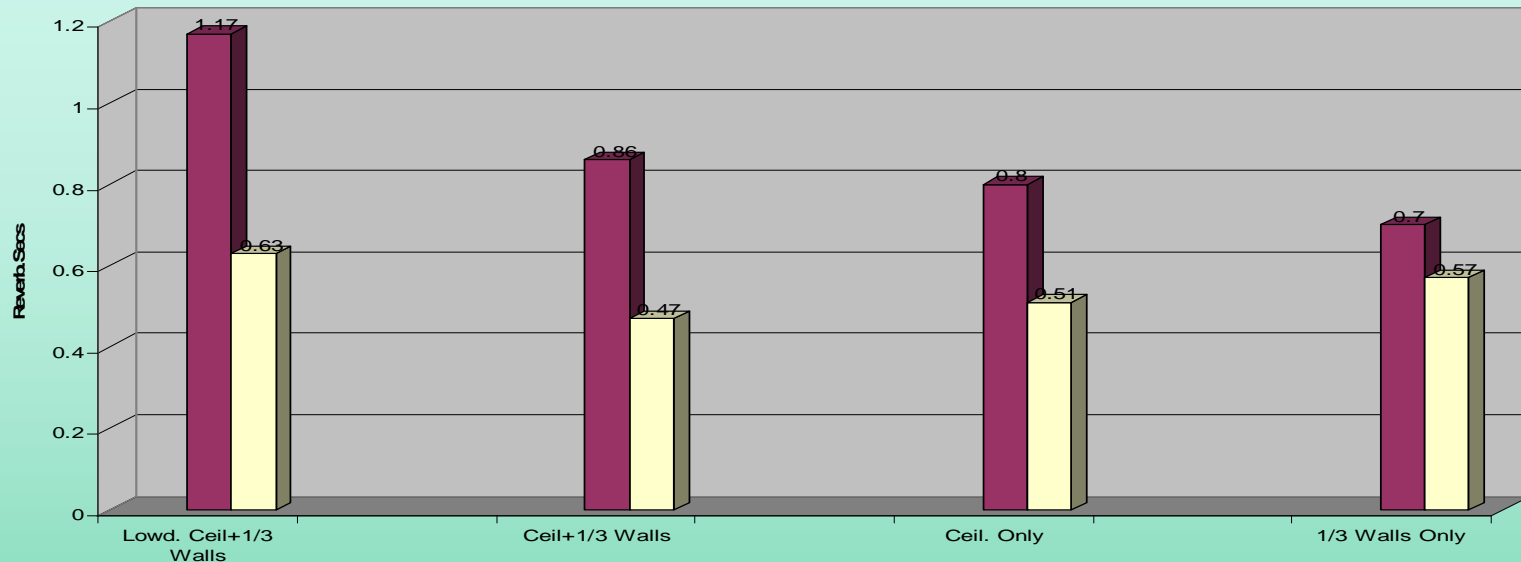
DISCUSSION

In Standard Rooms, acoustic ceiling +1/3 wall treatment would make a significant difference to teaching and learning and speech intelligibility (within Std.)

Mineral-fibre ceilings and wall treatment contributed significantly to RT reduction.

1/3 Wall treatment only in Standard Rooms may not provide a noticeable difference to teaching and learning and speech intelligibility.

REVERBERATION – Pre/Post Large Rooms



Series 1
Series 2
Series 3

FINDINGS

Lowered ceiling + 1/3 wall treatment produced an RT average reduction of 0.54 secs
Ceiling (mineral fibre) and 1/3 wall treatment produced an RT average reduction of 0.39 secs.

Ceiling only treatment produced an average RT reduction of 0.29
1/3 wall treatment only produced an average RT reduction of 0.13

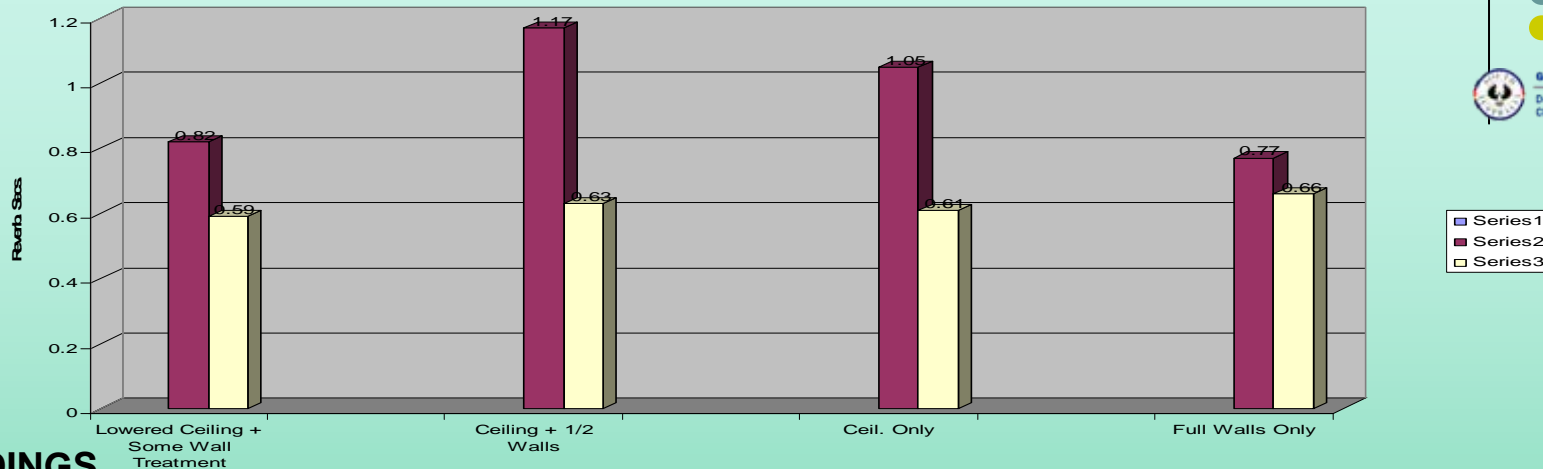
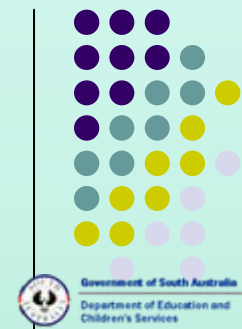
DISCUSSION

Lowered ceiling and ceiling (mineral fibre) + wall treatment both produced significant reduction in RT (within Std)

In Large Rooms, acoustic ceiling +1/3 wall treatment would make a significant difference to teaching and learning and speech intelligibility (within Std)

1/3 Wall treatment only in Large Rooms may not provide a noticeable difference to teaching and learning and speech intelligibility.

REVERBERATION – Pre/Post Extra-Large Rooms



FINDINGS

Lowered ceiling and some wall treatment an RT average reduction of 0.23 bringing the rooms into and close to the Standard. (highest volume rooms 300-420 m³)

Ceiling and ½ wall treatments produced an RT average reduction of 0.54 seconds bringing the rooms into and close to the Standard.

Ceiling only treatment (mineral fibre) produced an RT average reduction of 0.44 secs (one sample only).

Full wall treatment only produced an RT average reduction of 0.11 secs.

DISCUSSION

Ceiling and ½ wall treatments in Extra Large Room produced a RT reduction of 0.54 secs in open space learning areas and may make a significant difference to teaching and learning and speech intelligibility and could be the result the NRC rating.

Ceiling only treatment using mineral fibre in Extra large Rooms may make a significant difference to teaching and learning and speech intelligibility and could have been achieved by product NRC rating.

Full wall treatment may not make a difference to teaching and learning and speech intelligibility

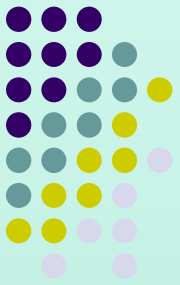
← Pre upgrade



Post upgrades



Summary

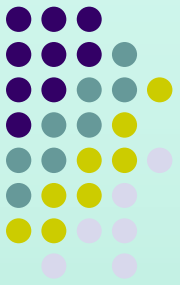


The data indicated :-

- 1. All up-graded split level air-conditioners met the Aust. Standard.**
- 2. All up-graded learning spaces produced a reduction in RT.**
- 3. All ceiling treatment including lowered ceilings produced significant reduction in RT (within Standard).**



Summary



4. The **VOLUME** of the learning space determines the extent of the acoustic treatment to achieve a difference in teaching/learning/speech intelligibility.

Standard rooms combination ceiling and wall treatment and ceiling only– significant difference.

Wall treatment may not provide difference.

Large Rooms ceiling and wall treatment – significant difference. Ceilings only also made a difference

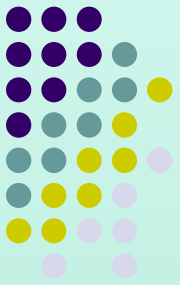
Wall treatment may not provide difference.

Extra-Large Rooms combination ceiling and wall treatment plus ceilings only – significant difference.

Full wall treatment may not provide difference.



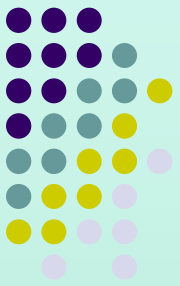
Summary



- 5. Noise Reduction Coefficient (NRC) rates of acoustic products – play a significant role in reducing RT.**
- 6. Mineral fibre products – may have a significant role in reducing RT – (best NRC).**
- 7. Addition of wall treatment in higher volume rooms further reduces the RT.**



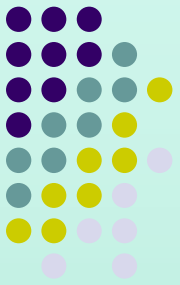
Recommendations



- **Exploring improved product quality as a result of product technology (best NRC rating).**
- **Addressing room volume in learning spaces to determine the application of the acoustic upgrade.**
- **Bi-annual collation of pre and post upgrade measurements to ensure upgrades meet DECS Acoustic Performance Standards and identify the effective applications and products that deliver the best acoustic advantage.**



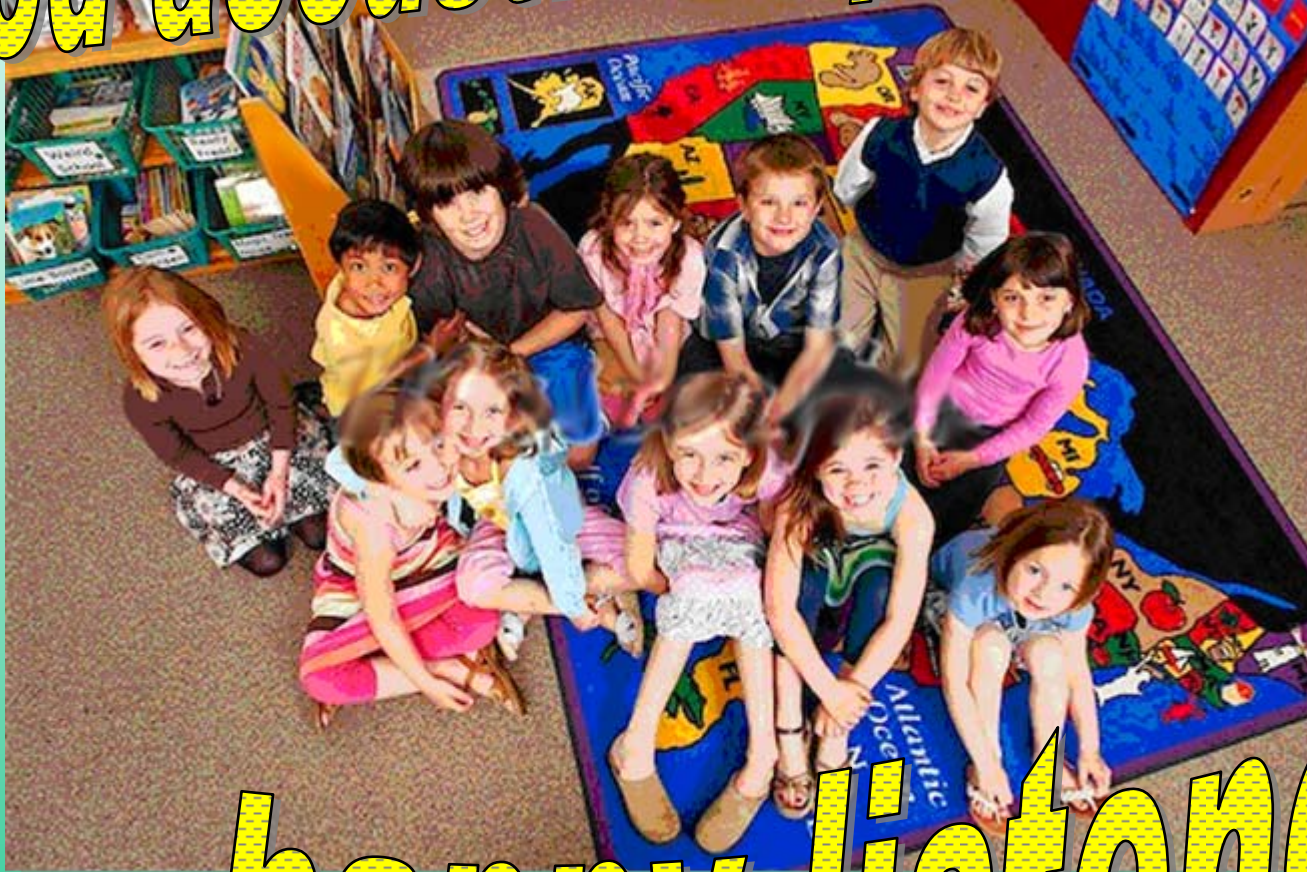
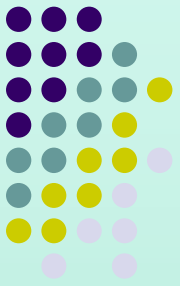
Recommendations cont.



- **Considering fitting of acoustic ceiling treatments with high NRC to all new learning spaces.**
- **Air-conditioning systems meet the recommended design sound levels for learning spaces as per Standards.**
- **Information sharing (also PD) between Hearing Services Coordinators and DECS personnel.**
- **Annual PD for DECS personnel and outsourced Facility Managers, show casing research results and products.**



Good acoustics equals ...



happy listeners

