

# Irrigation Testing and Evaluation at USQ



**Professor Steven Raine**  
**Professor Rod Smith**  
**Dr Joseph Foley**  
**Dr Malcolm Gillies**



A Research Centre of the University of Southern Queensland

# NCEA in Focus

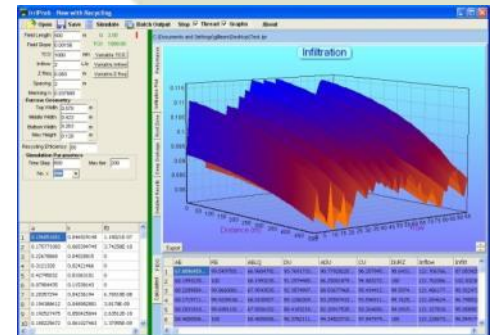
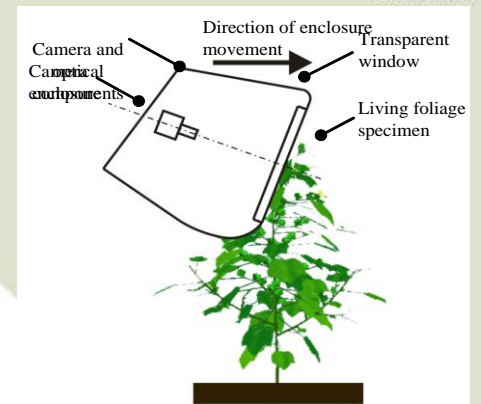


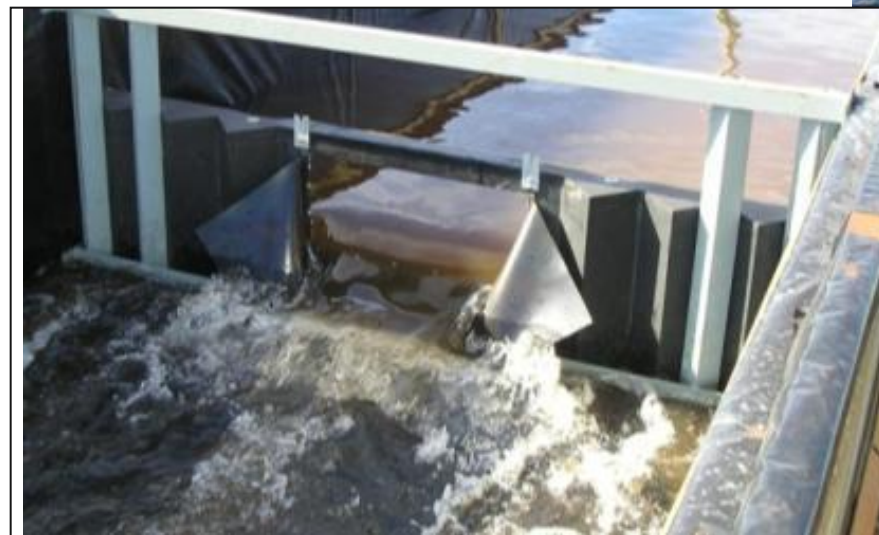
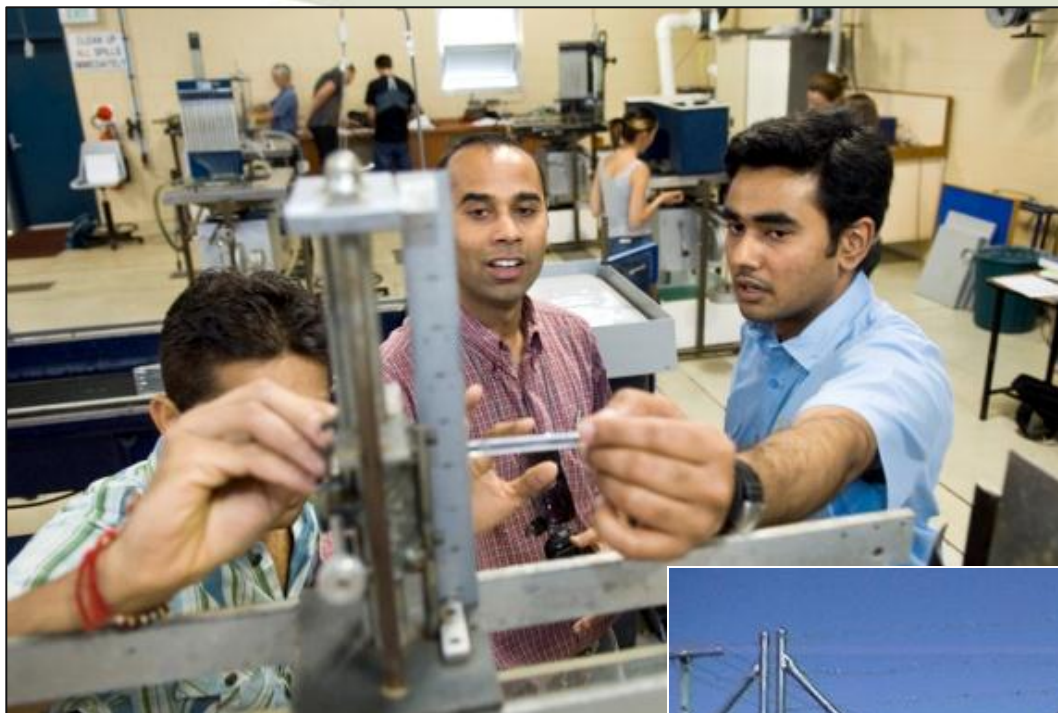
## NCEA & USQ

- Established 1994
- NCEA is 1 of 7 research centres (largest);
- Annexed to Faculty; only undergrad Ag Eng course; one of the largest post grad programs in Aust.
- Approx. \$3 million/yr in external grants

## Personnel

- >25 FTE (externally funded staff)
- >30 postgraduate research students
- Access to ~ 15+ additional research staff through FOES and commercial affiliations
- + > 5 National and International Adjunct positions





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# USQ Focus



- **Hydraulic laboratory facilities**
  - **Sprinkler evaluation**
  - **Pressure regulators**
  - **Siphon and gate discharge evaluations**
- **Hydraulic flume/channel control facility**
- **Evaporation test facility**
- **Some materials capability**

**Research & extension focus rather than routine equipment testing**

# Also a focus on infield evaluation

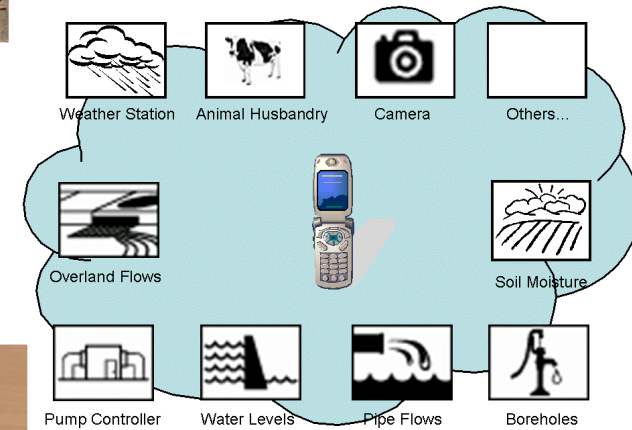
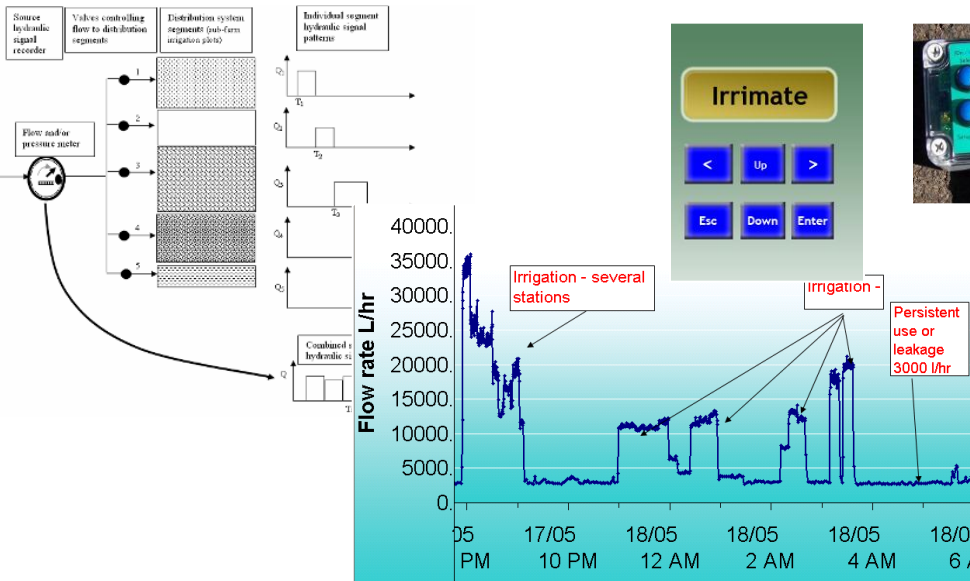
- **Infield evaluation systems**
- **Software tools for reporting and evaluation**
  - **Surface irrigation**
  - **Pressurised irrigation**
  - **Pumps**
  - **Farming systems (eg. nutrients, farm planning)**

# Developing Monitoring Tools



## Range of scales

- *Whole farm*
- *Pump/motor/bore hole*
- *Smart metering*
- *Infield performance*
- *Soil-water and solutes*
- *Crop sensing – scheduling & variability*



**Wireless infield and whole farm networking**



# Developing Analysis Tools



## Infiltration/evaluation/optimisation

- discharge analysis (GPipe)
- infiltration with variable inflow & run-off & variability along furrows
- reducing advance data requirements (MIC)
- whole field evaluation/optimisation (IrriProb)

**Primary (Fixed) condition** Input Head

**Supply**  
Head at Supply: 0.5 m  
Pipe Type: Rigid  
Pipe Length: 10 m  
Pipe Dia: 0.2 m  
Pipe Roughness: 130  
Slope: 0 m/m  
Extra Energy Losses: 0.35

**Pipeline**  
Pipe Grid: Flexible  
Pipe Length: 35 m  
Pipe Dia: 0.2 m  
Pipe Roughness: 140  
Slope: 0.005 m/m

**Outlets**  
Selected Segment: 16 of 18  
Outlet Type: Circle  
Gate Diameter: 0.05 m  
First Outlet Dist: 2 m  
Outlet Spacing: 2 m

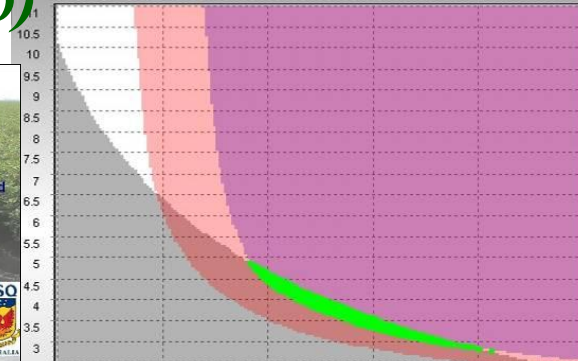
**Simulation Results:**  
Pressure Head at Valve = 0.3484 m  
Pressure Head at Supply = 0.5000 m  
Total Supply Energy = 0.4867 m (rel to End)  
Average Outflow = 2.73L/s  
Total Flow = 49.06 L/s (4.239 ML/day)

**IPARM V2**  
Infiltration Parameters from Advance and Runoff Model  
Copyright 2006  
Calibration of the Kostikov-Lewis infiltration function from field data

Developed by Malcolm Gillies  
gilliesm@usq.edu.au

Cooperative Research Centre for IRRIGATION FUTURES  
USQ AUSTRALIA

**Irrimate**



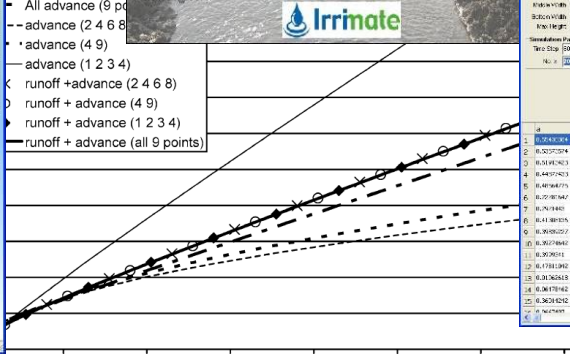
**Advance Data**

Distance (m)	Time (min)
0.00	0.00
110.00	45.00
220.00	57.00
330.00	162.00
440.00	257.00
550.00	367.00

**Runoff Data**

Distance (m)	Time (min)	Runoff (L/s)
0.00	0.00	0.00
110.00	45.00	0.00
220.00	57.00	0.00
330.00	162.00	0.00
440.00	257.00	0.00
550.00	367.00	0.00

**Model Fit Indicators**  
Error: 5.62499233  
Advance Error: 4.16457857  
Runoff Error: 1.46000376



**Deep Drainage**

3D surface plot showing the topography of a furrow, with axes for Distance (m) and Flow.

ID	X	Y	Z
1	0.000000	0.000000	0.000000
2	0.000000	0.000000	0.000000
3	0.000000	0.000000	0.000000
4	0.000000	0.000000	0.000000
5	0.000000	0.000000	0.000000
6	0.000000	0.000000	0.000000
7	0.000000	0.000000	0.000000
8	0.000000	0.000000	0.000000
9	0.000000	0.000000	0.000000
10	0.000000	0.000000	0.000000
11	0.000000	0.000000	0.000000
12	0.000000	0.000000	0.000000
13	0.000000	0.000000	0.000000
14	0.000000	0.000000	0.000000
15	0.000000	0.000000	0.000000
16	0.000000	0.000000	0.000000
17	0.000000	0.000000	0.000000
18	0.000000	0.000000	0.000000
19	0.000000	0.000000	0.000000
20	0.000000	0.000000	0.000000

# Visualisation & Optimisation Tools



**TRAVGUN V2.2**  
 Travelling Gun Simulation Model  
 Copyright 2005  
 Based on the original Travgun  
 3 model model by Geoff Newell  
 Theory by Geoff Newell, Rod Smith  
 and Jessop Foley  
 Developed by Malcolm Gillies

**NCEA**  
 National Centre for Engineering in Agriculture  
 University of Southern Queensland (USQ)

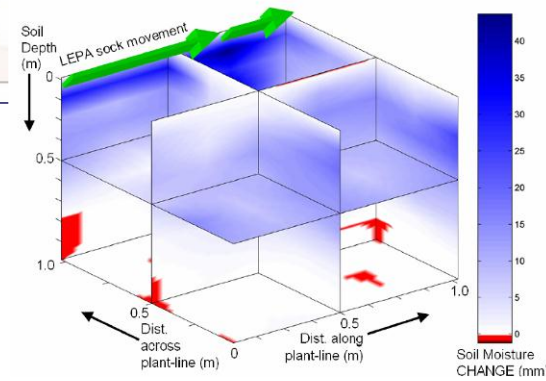
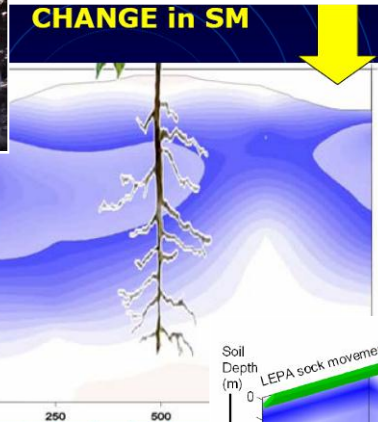
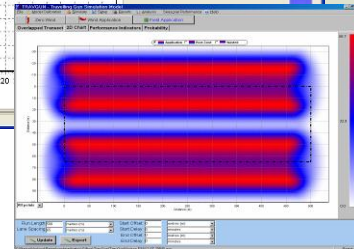
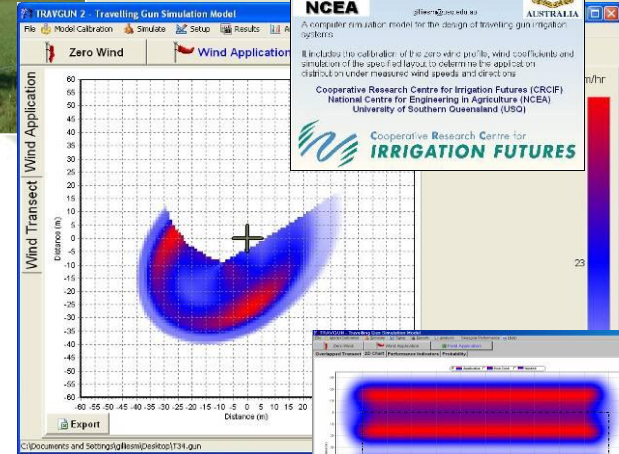
**USQ**  
 AUSTRALIA

A computer simulation model for the design of travelling gun irrigation systems.

It includes the calculation of the zero wind profile, wind coefficients and simulation of the speed and layout to determine the application distribution under measured wind speeds and directions.

Cooperative Research Centre for Irrigation Futures (CRCIF)  
 National Centre for Engineering in Agriculture (NCEA)  
 University of Southern Queensland (USQ)

**Cooperative Research Centre for IRRIGATION FUTURES**



**Design**

**Infiltration**

**OVERSched**

**OVERSched**

Plan View of Field: Centre Pivot

APPLICATION DEPTH ZONES  
 APPLICATION DEPTH (mm)  
 ②③④⑤⑥

SOIL MOISTURE PROBES  
 INITIAL DEFICIT (mm)

TOTAL SOIL MOISTURE (mm)

PROBE 1  
 DAYS

PROBE 2  
 DAYS

PROBE 3  
 DAYS

58 of 288 hours

Playing simulation

A Centre Pivot and Lateral Move management support tool for visualising soil moisture deficits and irrigation scheduling options

More about

Enter

**Scheduling**



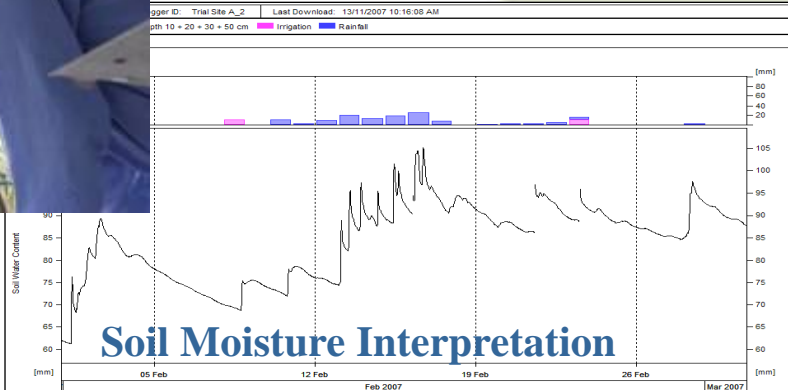
Pumps



# Training & Capacity Building



Technical support  
CP and LM irrigation  
systems  
Travelling guns



Performance Data  
Analysis



Soils & Scheduling



Pump Testing



[Logout](#) | [Change Password](#) | [Change Particular](#) | [Ticket](#)

KMSI is the Knowledge Management System for Irrigation, developed by the National Centre for Engineering in Agriculture with funds provided by the Queensland Government as part of the South East Queensland Irrigation Futures project.

All software

Farm dams

Irrigation  
assessment

Irrigation and  
crop records

Mapping

Energy use  
and GHG's

Benchmarking



### **EconCalc** [ Free Access ]

EconCalc is a decision support tool used to economically evaluate the costs and benefits associated with a new irrigation system. EconCalc calculates a number of economic performance indicators such as i) Nett Present Value (NPV); ii) annualised costs / benefits (annuity); iii) the internal rate of return (IRR) and the Benefit Cost Ratio.



### **EnergyCalc**

EnergyCalc assesses direct on-farm energy use, costs and the greenhouse gas emissions (GHGs) associated with diesel, petrol, LPG and Electricity consumption. EnergyCalc examines energy use across key processes within a production system and can be used to evaluate farming practices such as tillage, spraying, irrigation etc.



### **Gmap**

Gmap is a map request and repository tool for irrigators in SEQ. The web portal provides a graphical interface that allows users to identify their particular farm based on a Google Maps environment. GMap facilitates the generation of farm resource maps with the appropriate organisation.



### IPART

The Irrigation Performance Audit and Reporting Tool (IPART) is designed to assist in the evaluation and collation of infield irrigation application system performance data. IPART provides a range of functions including standardisation of infield data record acquisition, calculation and presentation of infield irrigation performance evaluation indices, automated generation of grower recommendations and grower report generation.



### IPART Public Access [ Free Access ]

IPART Public Access is part of IPART and is used to view the Application Uniformity of Irrigation Systems. The performance of infield application systems is normally reported both in terms of the efficiency of application and the uniformity of application. The efficiency of the application system is calculated as the ratio of the water used by the plant relative to the water applied. The efficiency is primarily affected by the management of the irrigation and may vary significantly between irrigation events. However, the uniformity of application is primarily a function of the irrigation system design and maintenance. Low levels of uniformity limit the maximum efficiency achievable.



### IPERT

The Irrigation Pump Evaluation and Reporting Tool (IPERT) is designed to assist in the evaluation and collation of onfarm irrigation pumping system performance data. IPERT provides a range of functions including standardisation of on-farm data record acquisition, calculation and presentation of on-farm irrigation pumping system evaluation indices, automated generation of grower recommendations and grower report generation.



### IRUSTIC [ Free Access ]

IRUSTIC is a database reference tool used to identify the Queensland (SEQ). The IRUSTIC database contains simulation results averaged over a period from 1970 to 2007.



### ISID

The Irrigate Surface Irrigation Database, known by the acronym ISID, provides simulation results to facilitate benchmarking of surface irrigation industry levels. ISID is fully compatible with the Irrimate™ simulation tool. ISID is necessary to conduct simulation runs, system evaluation and system design. The system is generic and may be applied to a range of irrigation systems.



### Nutrient Balance and Reporting Tool

Nutrient Balance and Reporting Tool is an online nutrient management calculator designed with an interactive data record management system and tiered reporting capability. It will help with the interpretation of soil test values, and record nutrient requirements, actual fertiliser inputs and subsequent productivity data. The data captured by Nutrient Balance and Reporting Tool can also be used to assist broader-scale interpretation (e.g. district, regional or industry scales) and trend analyses.



### ReadyReckoner [ Free Access ]

The 'Ready Reckoner' performs a simple, site-specific economic assessment of the viability of evaporation mitigation systems. The user enters appropriate data to customise the 'Ready Reckoner' to their site.



### RESSTAT

RESSTAT is an on line irrigation survey questionnaire that can be used to report regional irrigation statistics and benchmark performance. The questionnaire covers details of property ownership and location, irrigated land, water availability and cost, annual irrigated production and area, water use and irrigation management. Questions on demographics, drivers for change and knowledge of rural water use efficiency programs are also included.



### Scheduling Irrigation Diary

The Scheduling Irrigation Diary is tactical decision support tool with simple irrigation recording and scheduling features based on evapotranspiration (ET). The Scheduling Irrigation Diary allows irrigators to record irrigation and rainfall while also calculating daily crop water use. The Scheduling Irrigation Diary assesses crop water needs (i.e. supply vs. demand) based on the actual irrigation amount, irrigation frequency, rainfall and crop water use.



### Water Manager Tool

The Water Manager Tool is a strategic decision support tool used to assess current irrigation management practices and the interactions between crop and irrigation system. The Water Manager tool also develops a personalised irrigation schedule and water budget for the grower based on the characteristics of the enterprise.



### Water Resource Info Tool [ Free Access ]

The Water Resource Info Tool consolidates information used by irrigators such as rainfall, ET, commercial storage levels, surface water and ground water information in a single location. Information publically available via



# IPART – Infield application evaluation



IPART - Windows Internet Explorer

http://ncea-linux.usq.edu.au/ipart/public\_search.php

File Edit View Favorites Tools Help

IPART

## Welcome to the Irrigation Performance Audit and Reporting Tool Public Access

[Summary](#) [About IPART](#) [What is an irrigation audit?](#) [Current Auditors](#) [Becoming an Auditor?](#)

### Summary Page

There are currently 848 records in the database collected between 19-10-2000 and 03-11-2012

#### Summary of Current Records

Region	No. of Records	Application System	No. of Records	Crop (Top 10)	No. of Records
Qld	768	Travelling Gun	110	Pasture - Dairy	161
NSW	15	Travelling Boom	32	Nursery - Other	117
Vic	13	Side Roll	33	Lucerne	70
WA	6	Hand Shift	28	Turf - Couch	45
NZ	0	Solid Set	262	Nursery - Protected	37
SA	0	Lateral Move	40	Flowers - Other	30
		Centre Pivot	196	Cotton	27
		Drip	56	Tree - Avocado	21
		Microsprinkler	91	Sugarcane	20
				Grain	18

Local intranet 100%

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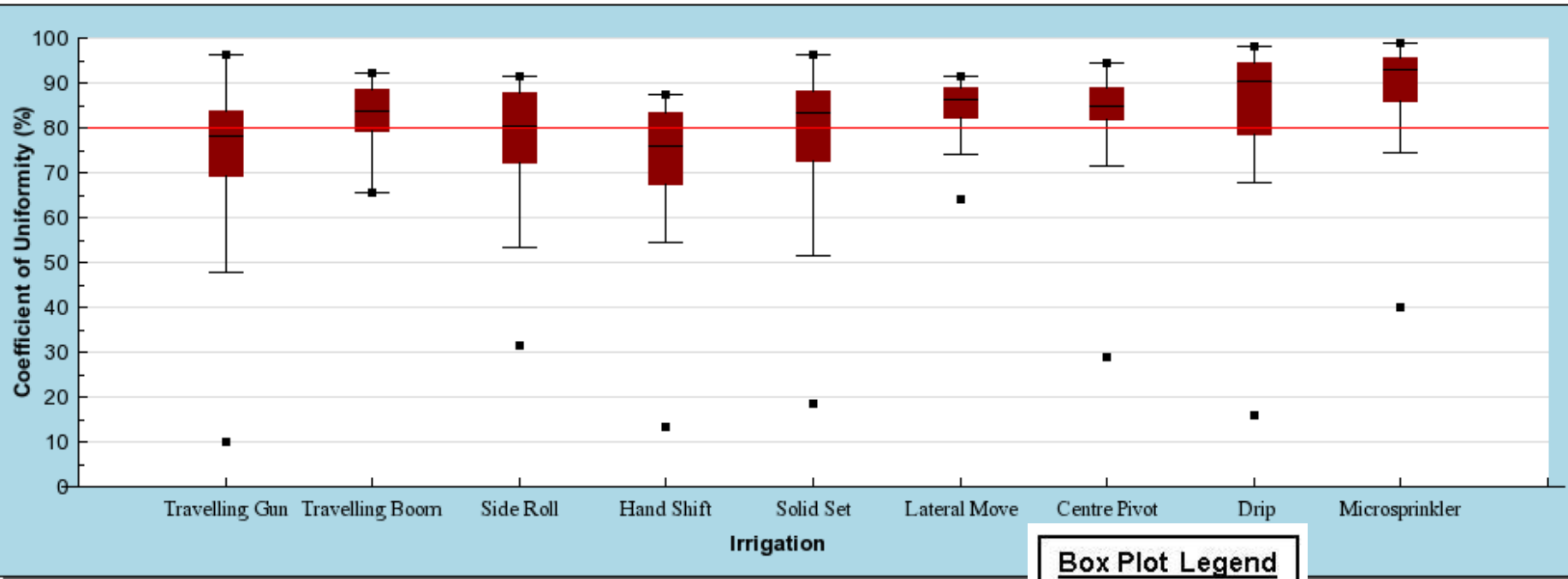
6:02 AM

[http://ncea-linux.usq.edu.au/ipart/public\\_search.php](http://ncea-linux.usq.edu.au/ipart/public_search.php)

# 848 records in the database



Application Uniformity of Irrigation Systems



### Box Plot Legend

- Max
- 75%
- Median
- 25%
- Min
- Performance Indicator for All Systems (80%)
- Extreme Outliers

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