Floodplain Harvesting in NSW

Daniel Connor – Healthy Floodplains Project Lead
Daniel Blacker – Director, Water Programs & Performance
Floodplain Harvesting engagement – today’s agenda

• Welcome & session overview
• Context: NSW and MDB perspectives:
  • Regulatory frameworks
  • Modelling & assumptions
  • Opportunities for feedback
• Technical presentations:
  • Modelling
  • Data sources & checks
  • Peer-review process
  • Monitoring & auditing
• Next steps:
  • Opportunities for feedback
Floodplain Harvesting engagement - overview

- NSW Government has decided to regulate the practice of Floodplain Harvesting – we are now moving into modelling and implementation of this policy
  - Today’s focus is **not** on the policy decision
  - Today’s focus **is** on implementation, modelling, auditing and monitoring

- Purpose of this meeting:
  - Outline the process to give feedback on the methodology
  - Outline the process for finalising floodplain harvesting modelling
  - Outline the model refinement process (including data sources & verification processes)
  - Test key modelling assumptions
  - Meet the team, including peer reviewers
Water Reform in NSW – an ongoing process

<table>
<thead>
<tr>
<th>Water Metering Framework</th>
<th>Water Sharing Plans</th>
<th>Licensing</th>
<th>Supply Measure Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protecting Environmental Flows</td>
<td>Long Term Environmental Watering Plans</td>
<td>Work Approvals</td>
<td>Efficiency Measure Projects</td>
</tr>
<tr>
<td>Transparency in water management</td>
<td>Water Quality Management Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compliance &amp; Enforcement Regimes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Who is responsible for what in water?

**State**

<table>
<thead>
<tr>
<th>State Agency</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Industry – Lands &amp; Water</td>
<td>Responsible for planning, policy development and the regulatory frameworks for regional water in NSW.</td>
</tr>
<tr>
<td>Water NSW</td>
<td>Supplies and seeks to improve availability of water in NSW as the state’s bulk water supplier and system operator.</td>
</tr>
<tr>
<td>Natural Resource Access Regulator</td>
<td>Responsible for compliance and enforcement of the water regulatory framework.</td>
</tr>
<tr>
<td>NSW Office of Environment &amp; Heritage</td>
<td>Manages environmental water within NSW and develops long term environmental watering plans as required under the Basin Plan.</td>
</tr>
</tbody>
</table>

**Federal**

<table>
<thead>
<tr>
<th>Federal Agency</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murray Darling Basin Authority</td>
<td>Responsible for planning the basin’s water resources, with all planning decisions made in the interest of the basin as a whole and prepares, implements and reviews integrated plans for the sustainable use of the basin’s water resources.</td>
</tr>
<tr>
<td>Commonwealth Environmental Water Holder</td>
<td>Manages the Commonwealth’s environmental water holdings to protect and restore environmental assets in the Murray Darling Basin and in other areas where environmental water is held.</td>
</tr>
<tr>
<td>Department of Agriculture and Water Resources</td>
<td>Responsible for the management and use of water resources, including the National Water Initiative, the Murray-Darling Basin Plan, urban water policy and reform, and water quality improvement, as well as administering key Commonwealth funding programs relevant to water management reforms.</td>
</tr>
</tbody>
</table>
Floodplain harvesting and the Basin Plan

October 2018

Tony McLeod – General Manager, SDL Accounting and Aboriginal Partnerships
Basin Plan implementation

- Water Act 2007
  - MDBA
  - Basin Plan
- Basin Plan development
  - Basin Plan work starts
  - New water trading rules
  - Strategy to advise use of environmental water
  - Long-term state environmental watering plans
  - Northern Basin Review completed
- Water resource plans development
- Sustainable diversion limits in effect
  - We are here
  - Basin Plan evaluation
  - SDL adjustment projects to be completed
Sustainable diversion limits (SDLs)

• New limits on water use
• Limits for surface water and groundwater
• Science-based targets
• Baseline diversions
Changes to floodplain harvesting

- Improved measurement and compliance
- MDBA can ensure this use does not exceed the limits
Limits will continue to change

- Floodplain harvesting is not currently licensed and fully accounted for
- Will be incorporated under the Basin Plan
- This will see the sustainable diversion limit change
Fishing employs 10,000 people.

Largest & most complex river system in Australia.

Home to 2.6 million Australians.

Towns & rural communities rely on a healthy river system.

More than 40 Aboriginal nations.

$24 billion agriculture industry.

120 waterbird species & 46 native fish species.

Spans four states & one territory.

Australians visit their rivers & lakes for recreational & social activities.

$8 billion tourism industry.

9,200 irrigated agriculture businesses.

16 internationally recognised & protected wetlands.
Next steps

- This independent review
- Changes will be implemented along with the Basin Plan
- Improved measurement and compliance
NSW Floodplain Harvesting Policy

First introduced by NSW Government, 2013:
- Builds on previous reforms that set statutory water take limits for all take
- Provides a framework for licensing floodplain harvesting - essential for management
- Will reduce, not increase, the volume of water taken in the Northern Basin

Amended by NSW Government, 2018:
- Clarify that floodplain harvesting includes rainfall runoff
- Make special provisions for contaminated rainfall runoff
- Bolster monitoring requirements for floodplain harvesting
- Clarify eligibility criteria for floodplain harvesting
- Provide flexibility for the development of water sharing rules to occur through the water sharing planning process

The NSW Floodplain Harvesting Policy is not up for debate in this forum.
Implementing the NSW Floodplain Harvesting Policy

Ambitious and unprecedented reform for Floodplain management in Australia, necessary to:

- Protect the environment and other water users from the impacts of unconstrained floodplain harvesting
- Provide security and certainty for legitimate floodplain harvesting activities to continue within statutory limits
## Modelling – engagement, to date

<table>
<thead>
<tr>
<th>Who</th>
<th>Why</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPH Modelling Consultative Committee</td>
<td>Set up Irrigator Behaviour Questionnaire</td>
</tr>
<tr>
<td>Gwydir Valley Irrigators Association</td>
<td>Pilot valley – incorporating farm scale data/ initial results and individual impacts</td>
</tr>
<tr>
<td>NSW Agency</td>
<td>Oversight and advice on model utility</td>
</tr>
<tr>
<td>MDBA</td>
<td>WRP accreditation role relies on accepting new BDL estimate as ‘best available’</td>
</tr>
</tbody>
</table>
# Modelling – addressing stakeholder concerns

<table>
<thead>
<tr>
<th>Process</th>
<th>Area of concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshop #1 (Oct)</td>
<td>Why and how models are being revised and key assumptions</td>
</tr>
<tr>
<td>Peer Review (Nov-March)</td>
<td>That models are based on best available information and are technically robust</td>
</tr>
<tr>
<td></td>
<td>That Policy implementation is consistent with both legislative and policy requirements</td>
</tr>
<tr>
<td>Workshop #2 (May)</td>
<td>How the numbers have changed following peer review</td>
</tr>
<tr>
<td>Draft entitlements (May - Nov)</td>
<td>How it effects me as an irrigator</td>
</tr>
</tbody>
</table>
Key modelling assumptions

- Storage evaporation
- Irrigation
- Rainfall runoff
- Overbank flow harvesting
- Defining floodplain harvesting licences
Defining FPH licences

- FPH licences based on water entering permanent storages only
- Assumption considered critical to being able to credibly:
  - re-estimate FPH component of statutory limits
  - monitoring and auditing of FPH diversions
Beneficial flooding and other interceptions

Beneficial flooding

• multiple benefits – environment, grazing, cropping
• not regulated - model accounts for water as losses

Interception activities – one of Basin Plan requirements

• monitor impacts overtime
• if significant impacts – will drive policy response
Questions
Opportunities for feedback

• **Independent reviewers:**
  
  • **Tony Weber:**
    • National Leader, Water Modelling - Alluvium Consulting
    • Visiting Scientist, CSIRO
  
  • **Greg Claydon, PSM:**
    • Water & NRM Consultant
    • Formerly WA & Qld Water / Environment / Natural Resources / Primary Industries agencies)
Stakeholder consultation framework – FPH Independent Review timeline

- **Open for stakeholder input**
  - Written submissions

- **Review team to study concerns**
  - Stakeholder comments reviewed
  - Issues identified, aligned Terms of Reference
  - Clarifications discussed
  - Review scope developed by 30 Nov

- **Review scope**
  - Scope of review finalised
  - Concerns discussed

- **Complete desktop review**
  - Materials reviewed

- **Draft review available**
  - Draft review to DoI, MDBA and stakeholders
  - Submissions to be submitted by 1st March 2019.

- **Presentation of findings**
  - Final version of the review presented at workshops in April/May 2019

Timeline:
- 8 Oct
- 16 Nov
- 30 Nov
- 1 Dec 2018 to 31st Jan 2019
- 1st Feb 2019
- April/May 2019
Modelling for estimating floodplain harvesting volumetric entitlements – September 2018

Richard Beecham – Manager, Water Modelling
The challenge

• Modelling responsibility to determine entitlements
• Estimate how much is being taken, allowed, and how to reconcile through entitlements:

• Pre-existing models fit for prior purposes:
  • Policy, planning, diversion compliance
  • BUT limitations for FPH
• Unprecedented detail and geographic scope
• We welcome your input
Modelling outline

- Existing modelling framework and limitations
- Enhanced modelling process
- Data collection and verification
- Scenarios and entitlements
Why we model

• To integrate all key processes that affect water distribution over time and space, within defined catchments

• Objective. Transparent. Consistent. Valid.
Model essentials

Water Sharing Plan rules and sharing
Crop planting decisions
Storage operation

Management

Biophysical

Rain
Evaporation

Runoff, routing, losses
Storages, evaporation
Demands, diversions

Allocations, account balance, etc
Flows, diversions, stored water, runoff, soil moisture etc
Full river system representation:

- Addressing complexity
Climate variability

- Long term observed climate used
- Extrapolates recent experience
- Benchmark for comparison

Inflow

- Driest
- Wet
- Dry
- Wettest
River section – typical detail
River section – simplified in existing models

at 5pm on Friday 2 November.

DOWNSTREAM GAUGE

RAIN, EVAPORATION

LOCAL INFLOW

UPSTREAM GAUGE

LOSS FROM REACH =
UPSTREAM FLOW = LOCAL INFLOW — EVAPORATION + RAIN — METERED DIVERSIONS — DOWNSTREAM FLOW

— transmission loss + unmetered usage + breakouts to floodplain + mass balance correction
Limitations for implementing policy objectives

- Existing aggregation of farms does not:
  - allow determination of individual farm water balance based on unique characteristics
  - provide means to limit total diversions.
- Assumptions in system loss estimates and crop water usage contribute to existing uncertainty.
- Explicit attention to these assumptions to reduce (not eliminate) uncertainty
- More data and enhancements to modelling.
Model improvement – accuracy and capability

Accuracy – Continual -incremental

Why, what, how
Design
Update
Build
Use

Additional data
Improve accuracy

Data, guidelines, calibrate, test

Policy, planning compliance,

Capability - Quantum

Redesign
Upgrade
Build
Use

Model limitations
More detail needed
River section – typical detail

LOSS FROM REACH NO LONGER INCLUDES BREAKOUTS TO FLOODPLAIN
Major water balance changes

- Inflows don’t change
- Metered diversions don’t change
- Flow remaining in rivers does not change
- Previous high system ‘losses’ repartitioned:
  - Lower losses
  - Floodplain harvesting
What this means for Plan Limit

- Plan Limit and BDL are definitions, not numbers
- Model estimates long term average according to definition
- Floodplain harvesting already occurring was underestimated in existing models.
- Enhanced modelling re-estimates this component
- Plan Limit estimate will change to include this new information.
PART 2

Enhanced model and data
Process for determining FPH entitlements

1. Model enhancements & configuration
2. Calibration & Validation
3. Scenario modelling
4. Entitlement determination
## Key Model Enhancements

<table>
<thead>
<tr>
<th>Conceptual</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual farms instead of groups</td>
<td>More accurate infrastructure details (Farm survey and inspection, remote sensing)</td>
</tr>
<tr>
<td>Explicit flood breakouts, separated from instream losses</td>
<td>Complete farm water balance (all water sources)</td>
</tr>
<tr>
<td>Defined access to breakouts including order</td>
<td>Improved representation of various on-farm processes:</td>
</tr>
<tr>
<td>Separate runoff from developed and non-developed farm areas</td>
<td>✓ Storage and irrigation losses</td>
</tr>
<tr>
<td>Operation of storages</td>
<td>✓ Separate use of storages</td>
</tr>
<tr>
<td></td>
<td>✓ Irrigation application rate</td>
</tr>
</tbody>
</table>
Additional information for models

**Infrastructure**
- Farm survey
- Site inspections
- Remote sensing

**Cropping and runoff**
- Farm survey
- Remote sensing
- Regional data

**Climate and flow breakouts**
- SILO & HYDSTRA
- Flow paths (Landsat)
- Flood models

**Licences and water usage**
- Water access system
- Water licensing system

New model
Farm surveys

- Designed to provide information to configure and calibrate models
- Completed by farm and licensing staff
- Completeness
- Verification

![Availability of data from farm surveys diagram]
Multiple scales of model and process

River system scale

Reach scale

Farm scale

Total and developed area
Storages
Pumps
Entitlements
Area planting decision
Diversion, runoff, irrigation

• Licensing & metering
• Farm survey
• Remote sensing

Flood outbreak relationships
Floodplain storage
Farm access order
Flow routing
Outbreaks and losses
FP storage behaviour

• Gauged flow
• Remote sensing
• Farm survey

Public dams
Total flow network
All water users
WSP sharing
Resource Assessment
Inflows
Releases
Allocations
Accounting

• BOM-SILO
• Licensing & metering
• WaterNSW ops

• Farm survey
• Remote sensing
• Gauged flow
• Farm survey

NSW GOVERNMENT
Water balance critical for credible estimates

Over long term [ farm inflows = farm outflows ]

Farm inflows:
- General security diversions (GS)
- Supplementary access diversions (SA)
- Floodplain harvesting
  - Overbank flow (OBF)
  - Farm rainfall runoff (RR)

Farm outflows
- Storage net evaporation (EV)
- On-farm losses (FL)
- Irrigation (I)

\[ \text{GS} + \text{SA} + \text{OBF} + \text{RR} = \text{EV} + \text{FL} + \text{I} \]
On farm water balance
How we reconcile water balance

\[ \text{GS} + \text{SA} + \text{OBF} + \text{RR} = \text{EV} + \text{FL} + \text{I} \]

- General security diversions → measured data
- Supplementary access diversions → measured data
- Rainfall Runoff → modelled to long term average
- **Overbank flow → ?? Farm surveys, flow analysis**
- Evaporation → storage modelled from evaporation data and storage surface area
- Farm losses → farm surveys and regional averages
- Irrigation → farm surveys crop areas and standard crop demand techniques

- Ultimately – need sufficient inflows to irrigate historical crop areas
- Overbank flow largest unknown
Permanent on-farm storages

- All inflows and outflows through storages
- Farm surveys – range of sources of estimates
- Surveys provided most reliable volume
- LIDAR data collected for floodplain topography analysed and compared to surveyed → accurate
- Surveyed used, else LIDAR consistent total volume
- Landsat data (1986→) used to determine date of construction for development scenarios
Storages and evaporation

- All storages represented as single storage and configured to reflect on-farm management

- Composite Volume v Surface Area relationship

- Efficient use of storages to minimise evaporation

- SILO evaporation data acts on surface area ➔ EVAP

Irrigation

• Crop areas → farm survey verified and infilled by remote sensing
• Application rates → farm survey – wide variation – climate?
• Irrigation demand combination of crop factor and climate (rain, evap)
• Standard techniques used to determine crop factors (FAO56)
• Model application rates compared:
  • Australian Bureau Statistics
  • WaterSched Pro
  • Irrisat
Rainfall - Runoff harvesting

- Daily soil moisture model for each farm – irrigated / fallow / undeveloped
- Increased by irrigation and rain; decreased by evaporation
- Farm survey data incomplete
- Volumes calibrated to long term average runoff coefficients (% of rainfall)
- Regional research, stream gauging
On-farm runoff annual totals

Evaporation
Irrigation
Rainfall runoff
Overbank flow harvesting

Runoff as a percentage of Rainfall

- Irrigated Area
- Long-term Average (8.5%)

- Fallow
  - Long-term Average (4%)

- Non-developed
  - Long-term Average (2%)
Overbank flow harvesting

Flow breakout processes

• Flow thresholds at locations along a river reach above which water flows across floodplain
  • Identified by farm surveys and by remote sensing
  • Flow rates nominated in some farm surveys

• Rates at which water leaves:
  • Health Floodplains flood models
  • Flow calibration u/s gauge → d/s gauge
  • River flow v outflow look-up table

• Volume outflow – was system loss → reach storage
Overbank flow harvesting

Use of storages

- River
- Breakout
- Reach storage
- On-farm temporary storage
- On-farm permanent storage

Intake rates

Evaporation
Irrigation
Rainfall runoff
Overbank flow harvesting
Temporary storage verification

• Work or area on farm that can store overland flow temporarily prior to transfer to a permanent on-farm storage

• Surge areas, sacrifice fields and other facilities where water is stored opportunistically, for up to 2-4 weeks

• Subsequently infiltrates or evaporates (system losses term)

• How to estimate capacity and actual?

• Farm survey consistency, verification by Landsat:
  • Water Observation from Space (WOfS) [% dates 1986→]
  • Targeted image data analysis post overland flow event
Conclusion

✓ Best available data used – published or verifiable data where possible
✓ Significant amount of quality checking undertaken
✓ A comprehensive, robust model that accounts for varied inputs at a farm scale within a well tested river system model framework

❓ Seeking feedback on assumptions and other relevant published data sources
Entitlement determination
Scenarios for entitlement calculation

- Simulated long term average annual diversions (1895-2009)
- Plan Limit → Lesser of re-estimated CAP and Water Sharing Plan
- Current floodplain harvesting diversions determine growth in use
- Share of total floodplain harvesting diversions → 3/7/2008 eligible works
- Entitlements and accounting scale back growth to Plan Limit
- Calculation of entitlements equalises relative individual volumetric impact
Entitlement calculation (example)

Determine eligible unconstrained individual take

Export annual time series of floodplain harvesting for each farm

Entitlements calculated so that individual impact ≈ 10%

Licensing and rules remove growth, i.e. Current ≈ Plan Limit
Licensing impact

Bar graph showing the percentage of properties before and after licensing impact. The graph indicates a decrease of 10% in the after period compared to the before period.

Individual farm data points are shown, with a trend indicating a decline in annual take over the percentage range of properties.

NSW GOVERNMENT
Importance of data & continual improvement

• The more information we have for models, the more accurate our estimates

• We will continue to improve these estimates as more information becomes available
Questions
Floodplain Harvesting Monitoring and Auditing Approach

Nicola Mead – Healthy Floodplains Stage 2 Project Lead
Where we are:

- Currently no monitoring of floodplain harvesting diversions
- Capacity to monitor FPH diversions is one of the significant advantages of bringing these diversions into the licensing framework
Monitoring Approach

- Volumetric measure of take is required
- Propose self-reporting into iWAS
- Initial minimum requirement: gauge boards and storage volume curves
- Sophisticated systems may also be acceptable
• Verification:
  • NRAR to verify usage against other data sources (imagery, remote sensing etc.)

• Investigation/Auditing:
  • Risk based approach
  • On-ground auditing

• Compliance:
  • NRAR procedures apply
Monitoring approach review

- Approach evaluated in first 2 years
- Revised approach implemented, if required, 3rd year
- Enable transition to new and improved technologies
- Water Pilot Technology Program to assist concepts for innovative technologies
Remote determination of water take: Hydrospatial

- Provide method for determining water take using a water balance approach & remote sensing
- Includes estimation of on farm storage levels
Detecting changes to floodplain structures - UNSW

Airborne Imagery

Off River Storage
Levee Bank
Channel

Airborne LiDAR Height and Slope

2008 - 2015 Airborne LiDAR Difference
Blue Higher
Red Lower
Options for Temporary Storage Monitoring

1. No direct use from temporary storages
   • All take routed through permanent storage

2. Additional measurement devices:
   • Gauge boards
   • Flow meters
   • Pump meter/logs

3. Whole-of-farm water balance:
   • Based on total water use
   • Majority of take will be measured, some will be estimated
# Next steps

## Floodplain Harvesting Program

**Workshop Series 1**
- Outline process for finalising modelling and feedback on key assumptions

**Peer Review**
- Peer reviewer will consult bilaterally with stakeholders

**Workshop Series 2**
- Peer review outcomes and valley scale results

**Draft Individual Entitlements**
- 28 day submission period; FPH committee review of submissions

**Final Entitlements**
- Notification

## Monitoring & Auditing Strategy

**Workshop Series 1**
- Proposed Approach

**Finalise Draft Strategy**

**Workshop Series 2**
- Consultation on final draft

**Public Exhibition**
- Broad distribution and consultation – Have Your Say

- Feedback and additional consultation if required

- Final Monitoring and Auditing Strategy published

<table>
<thead>
<tr>
<th>OCT 18</th>
<th>NOV 18</th>
<th>DEC 18</th>
<th>JAN 19</th>
<th>FEB 19</th>
<th>MAR 19</th>
<th>APR 19</th>
<th>MAY 19</th>
<th>JUN 19</th>
<th>JUL 19</th>
<th>AUG 19</th>
<th>SEP 19</th>
<th>OCT 19</th>
<th>NOV 19</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BORDER, GWYDIR, BARWON – DARLING, MACQUARIE NAMOI</td>
<td>MONITORING &amp; AUDITING STRATEGY (ALL VALLEYS)</td>
<td>WORKSHOP OUTCOME REPORT AVAILABLE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Thank you for your contribution

Contact the Department of Industry Floodplains team:

floodplain.harvesting@dpi.nsw.gov.au

----------

Engage with the peer reviewers:

FPHreview@alluvium.com.au
OR
FPH Review, c/- PO Box 423, Fortitude Valley, Qld, 4006