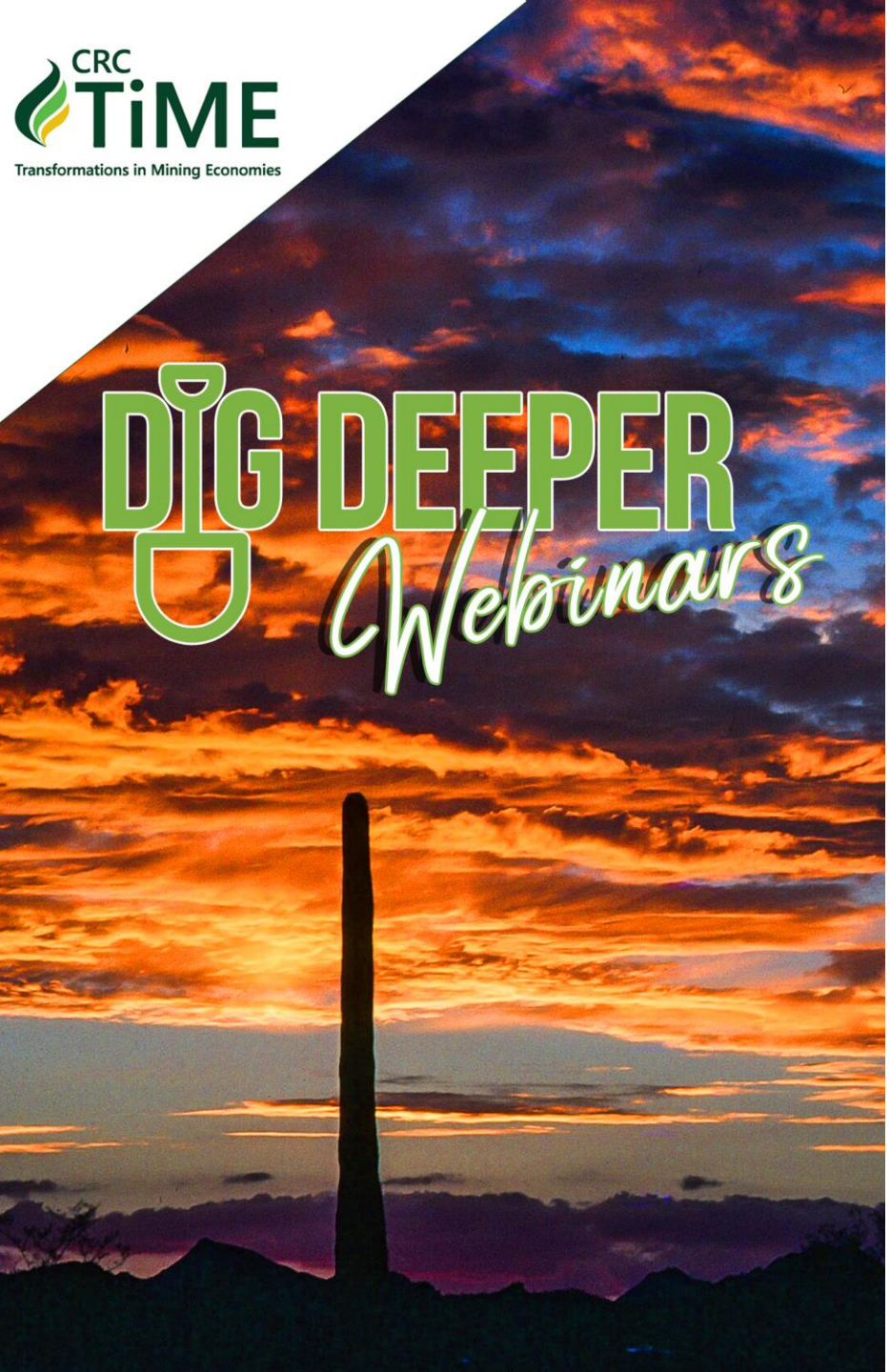

PROJECT F2.4

QUANTIFYING RISKS & OPPORTUNITIES

ED HOLLOWAY | 24TH JUNE 2022

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The Team

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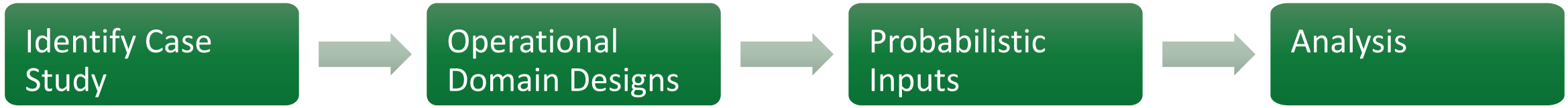
The Problem:

“THE” Plan…

Risks & Opportunities – Context

- Risks based distributions can be positive or negative
- Interrelationships between risks essential
- Integration of planning activities

The Research Process



- Suitably complex
- Existing strategic planning models

- Multiple design options
- Interrelated risks

- Commodity prices
- Groundwater
- Seismic
- Geotechnical

- Quantification of risk
- Interrelationships
- Impacts on strategic decisions

Project Objectives

- Incorporate operational domain design options into a strategic planning framework
- Probabilistic inputs
- Quantify associated risks
- Based on a flexible framework

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Case Study – Operational Context

- Tier 1 copper/gold operation
- Open pit
- Tropical, mountainous region
- High rainfall
- Seismically active

Case Study – Operational Context

- Waste dump design options
- Ultimate pit size
- Waste dump size

- Commodity price

Risks Quantified

Waste Dump Based Risks

- Failure size
- Production impacts
- Impacts on other waste storage capacities

Ultimate Pit Based Risks

- Residual resource risk
- Excess stripping risk

Values presented are based on standard NPV

Probabilistic Analyses

Geotechnical scenarios

I. No groundwater and no seismic
II. No groundwater and critical seismic
III. Groundwater and no seismic (Bishop)
IV. Groundwater and no seismic (Janbu)
V. Groundwater and seismic (Bishop)
VI. Groundwater and seismic (Janbu)

Groundwater scenarios

I. Hydraulic conductivity of face
II. Hydraulic conductivity of dump core
III. Hydraulic conductivity of drains

Mining/commercial scenarios

I. Small to large ultimate pits (Cu price: USD$1.00/lb - USD$5.00/lb)
II. Operating commodity price ranges (Cu price: USD$1.00/lb - USD$5.00/lb)

Concept Overview

- Assess and quantify risks
- Quantify how these relate to & impact on value
- Determine if this would impact on strategy

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RESULTS

BASED ON THE LARGEST DUMP OPTION

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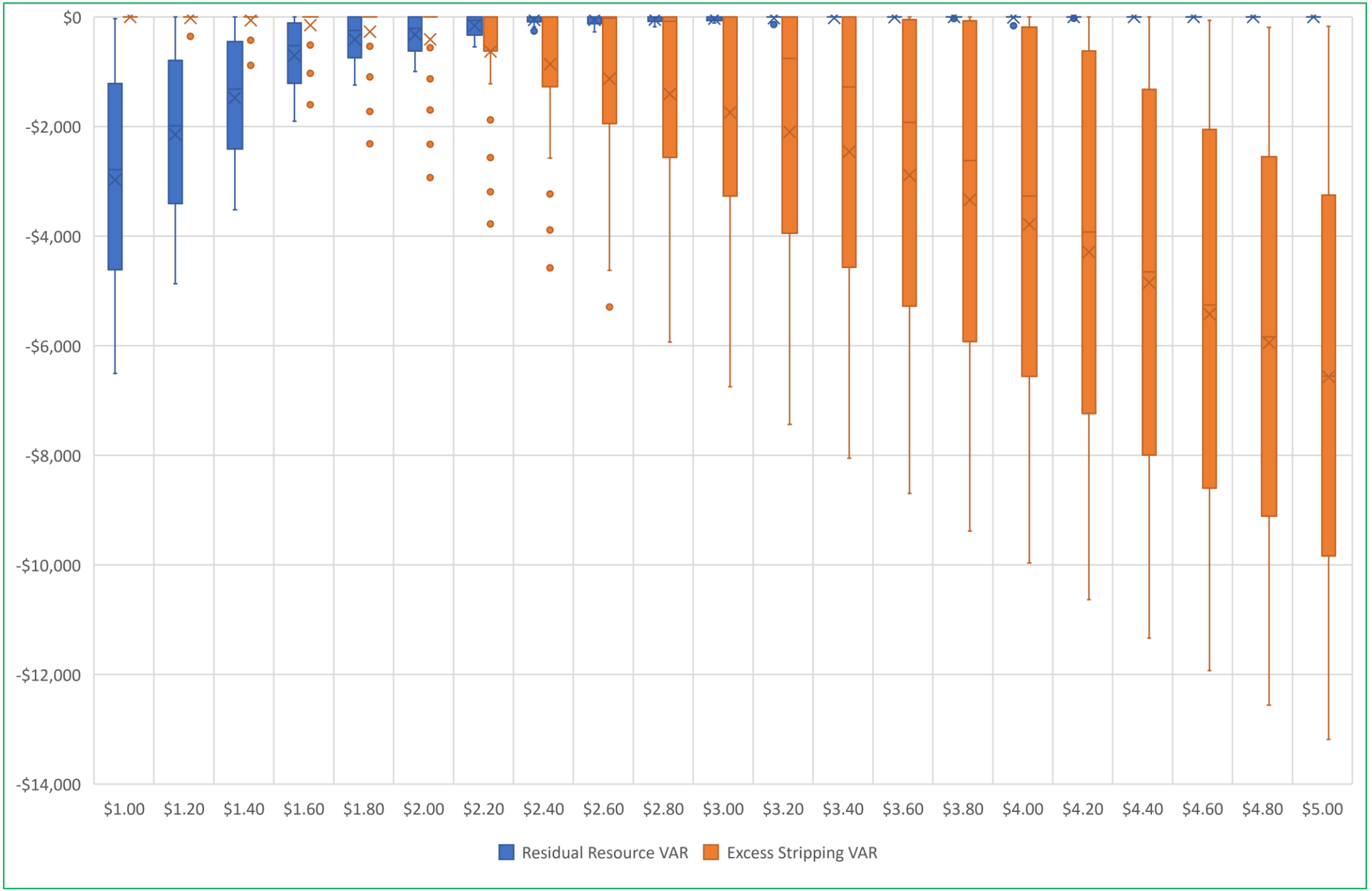
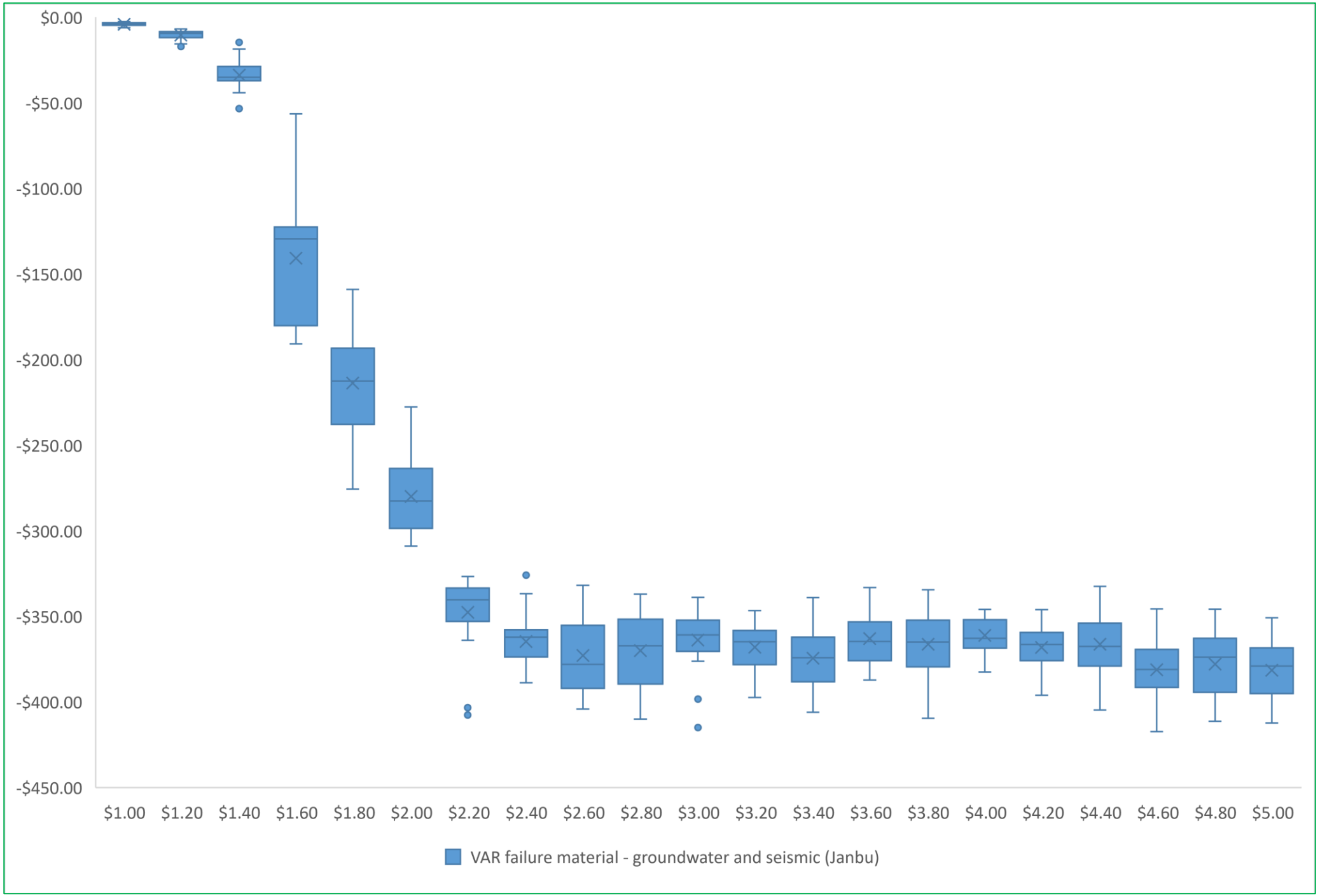
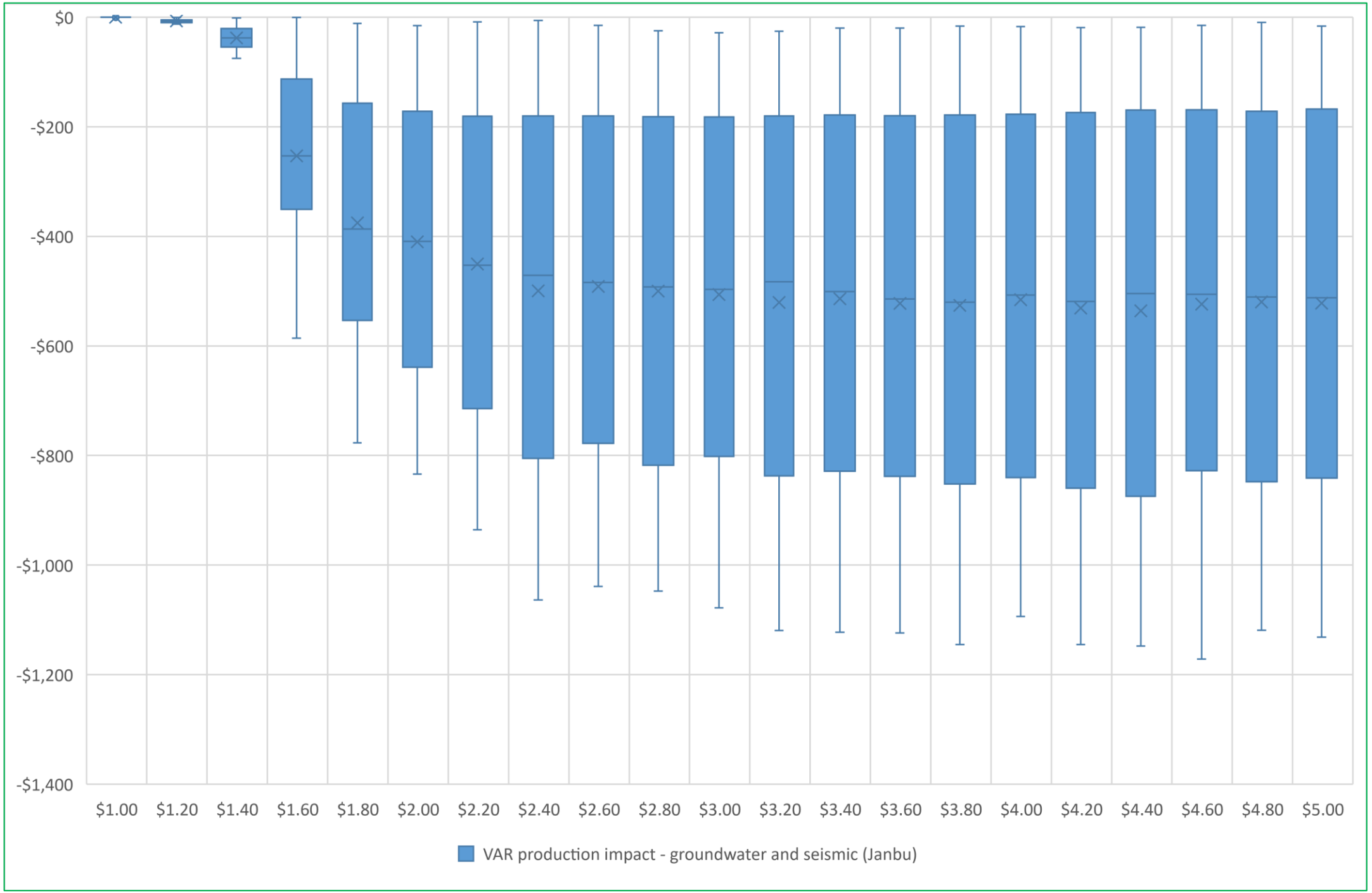
VAR – COMMODITY PRICE



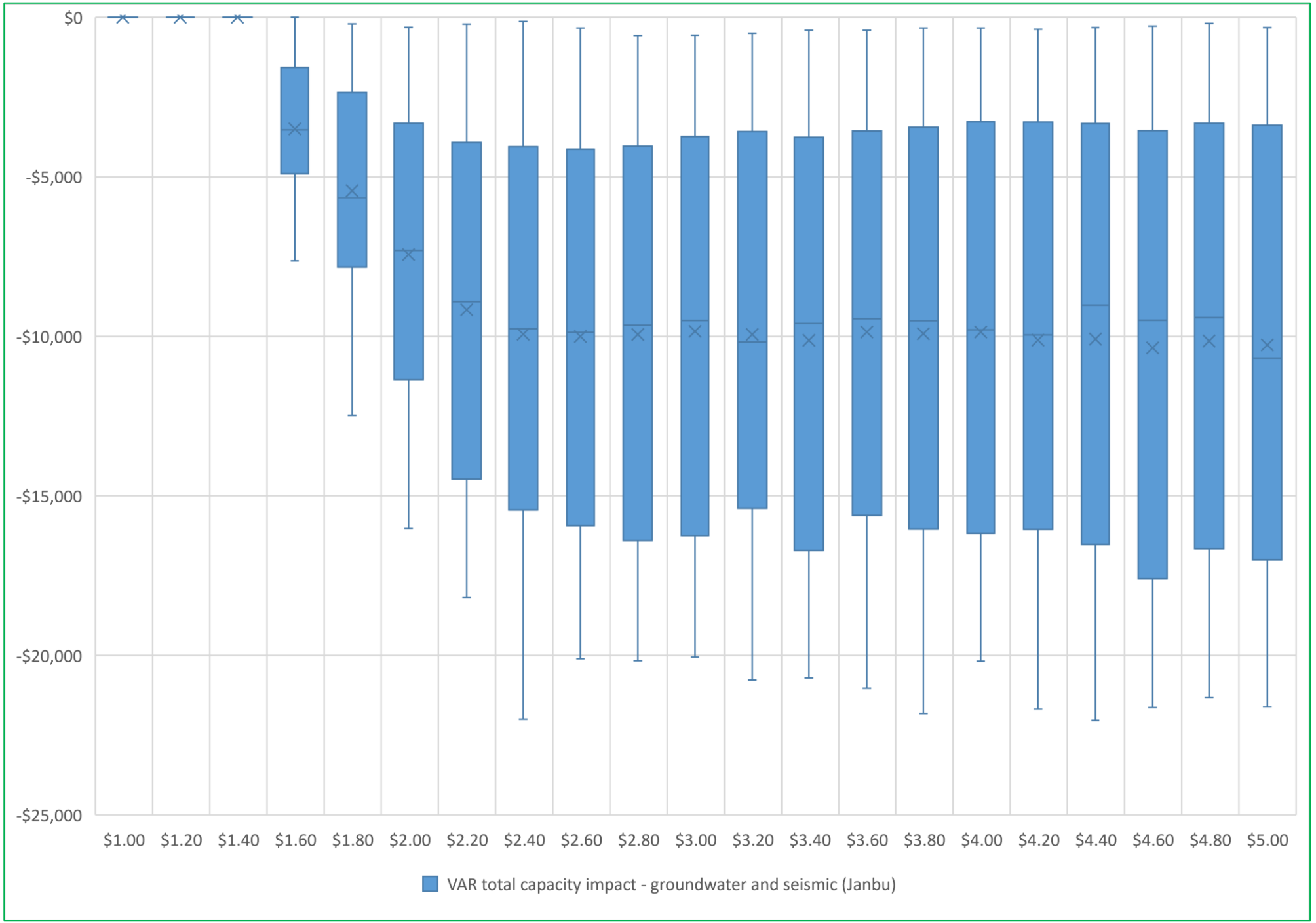
VAR – DUMP FAILURE



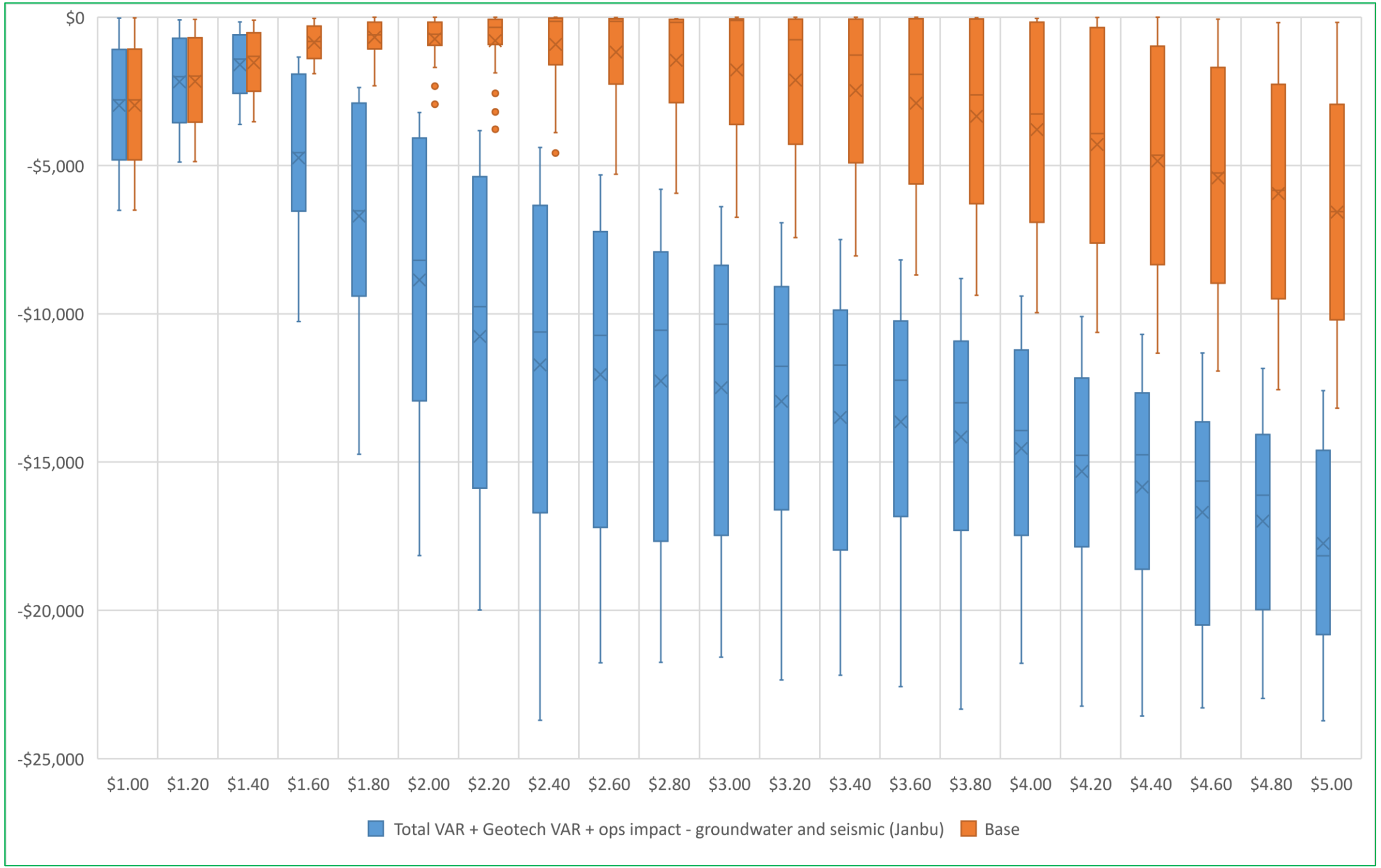
VAR – PRODUCTION IMPACT



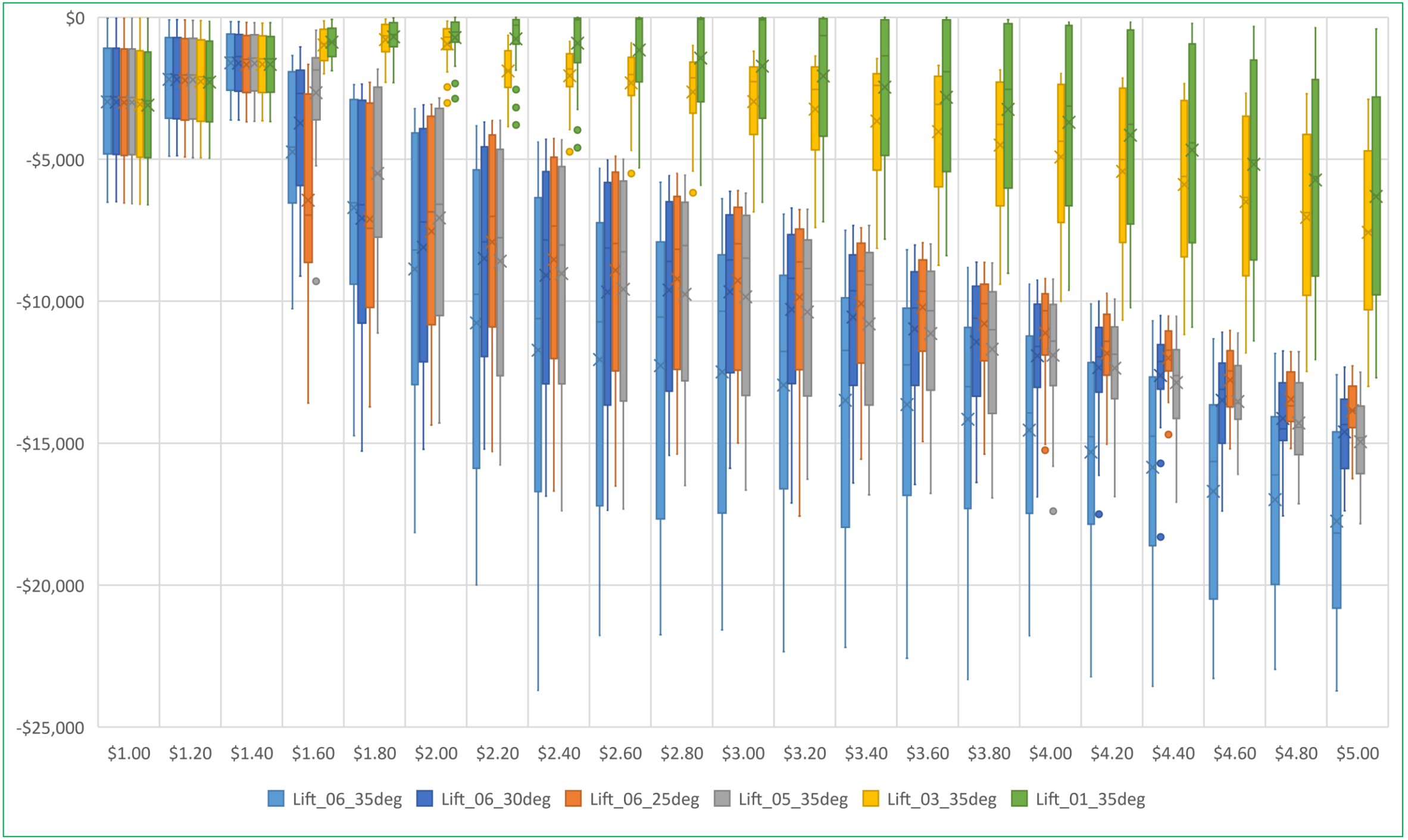
VAR – IMPACT ON OVERALL WASTE MANAGEMENT



VAR – GEOTECH + COMMODITY PRICE



WASTE DUMP DESIGN SCENARIOS



Key Findings

Risks can be quantified

- Probabilistic inputs
- Focused risks
- Impacts strategy

Mandates integration

- Understanding of risks
- Greater level of analysis

Achievable

- Involves more effort
- Scalable computing

How can Industry use these Findings?

- Informed strategic decision making
- Supporting communication between stakeholders
- Ingrains integrated planning
- Structured capture of corporate IP (wrt risks)
- Understanding of risks by decision makers

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Implications

- Understanding and quantifying risk is possible
- More effort = superior strategic decision making
- Knowledge = confidence
- Risk reduction – operational, post-closure (& transition)
- Improved communication between all stakeholders

Future Research

- Expanded framework
- Risk typology + methodology
- “How to” use…
- Incorporation of a wider range of risks
- Collaboration with other CRC TiME projects

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THANK YOU

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