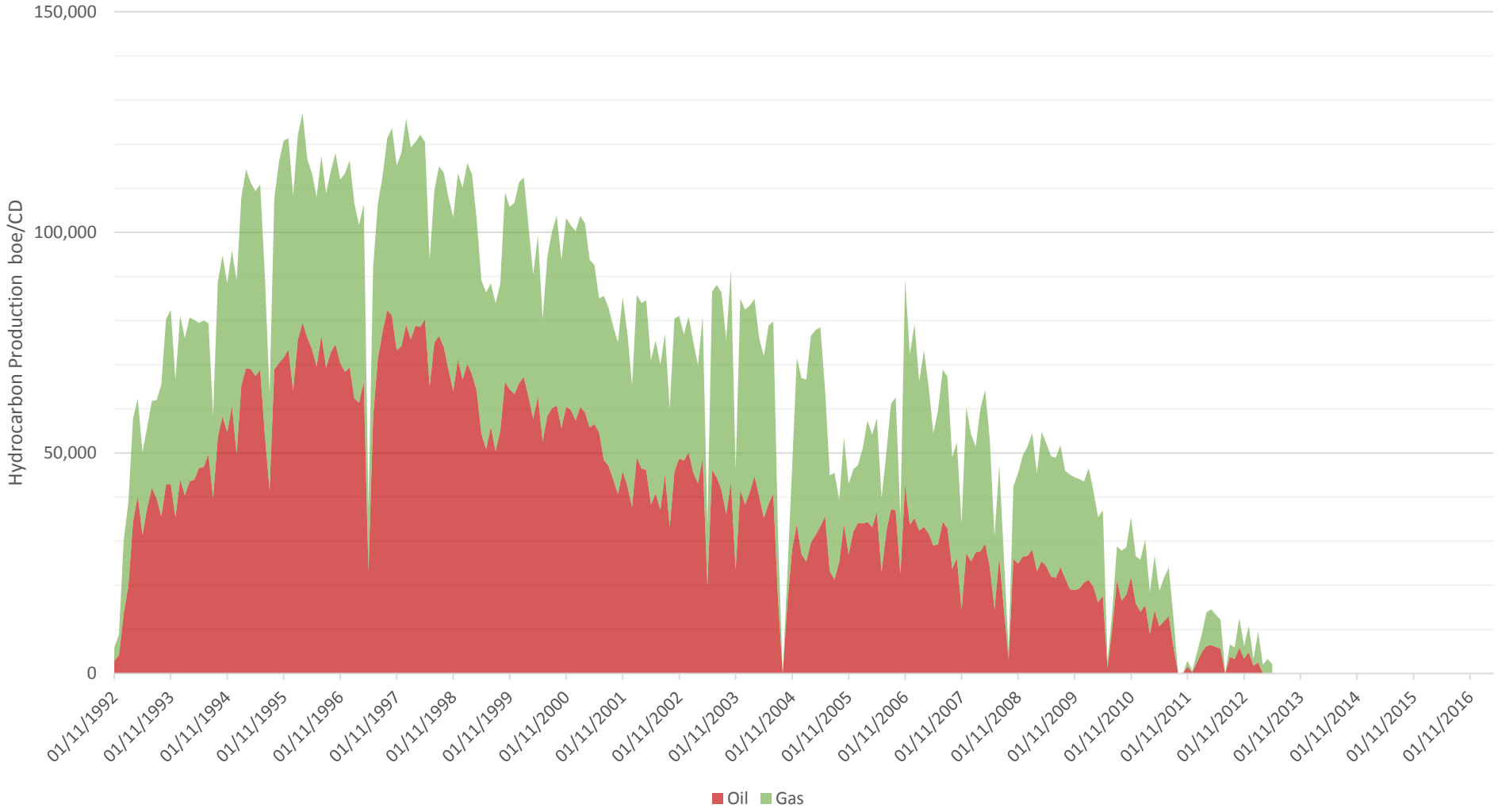
Gannet – A Story of Recovery

DEVEX
Tuesday 9th May, Aberdeen AECC

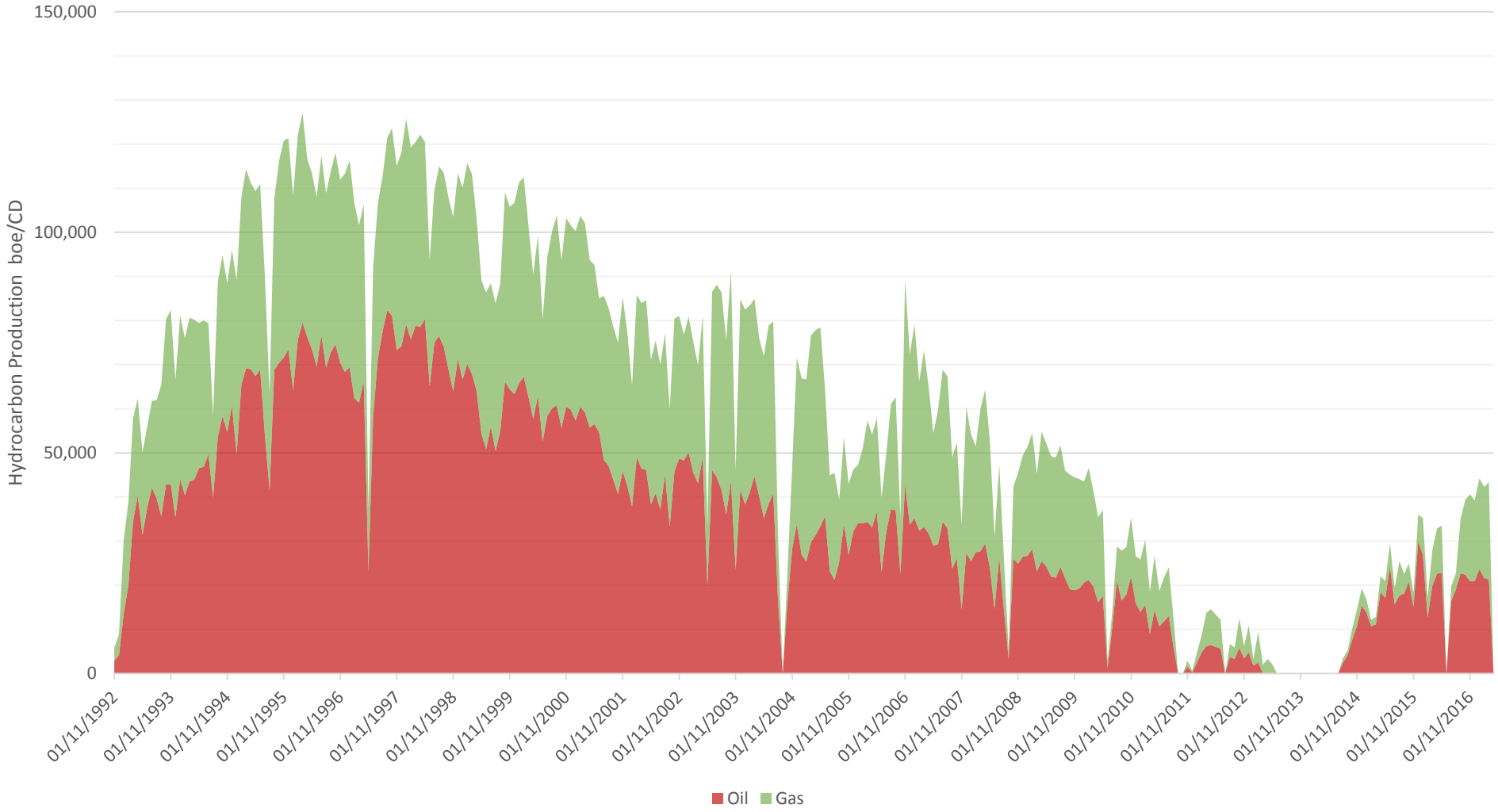
Cliff Lovelock
Senior Production Geologist, Shell U.K. Limited

Gannet G: First pull head on pipe lay vessel, March 2017

Gannet Historical Production 1992-2013



Gannet Historical Production 1992-2017



Agenda

Introduction to the Gannet Cluster

Building Confidence with Quick Wins

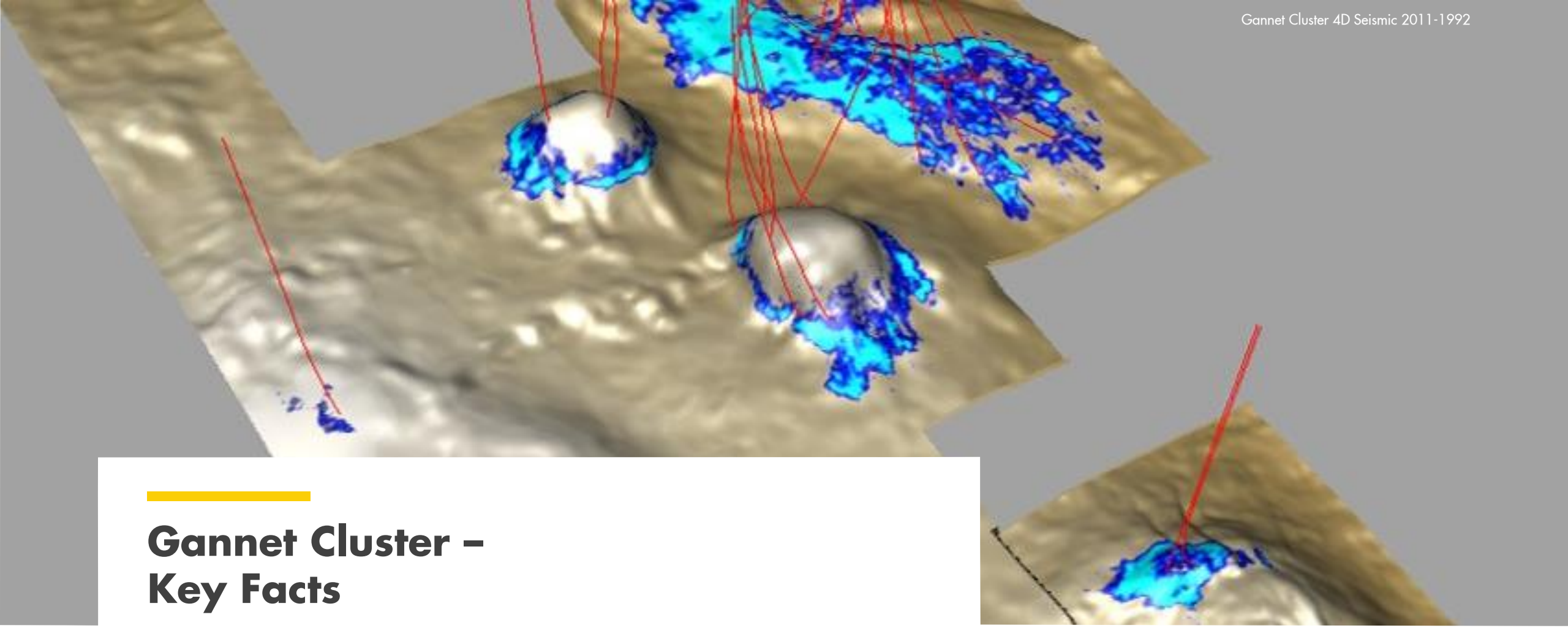
- Leverage your historical data
- Accept the risk

Success Breeding Success

- To grow you have to grow

Credible + Affordable = Achievable

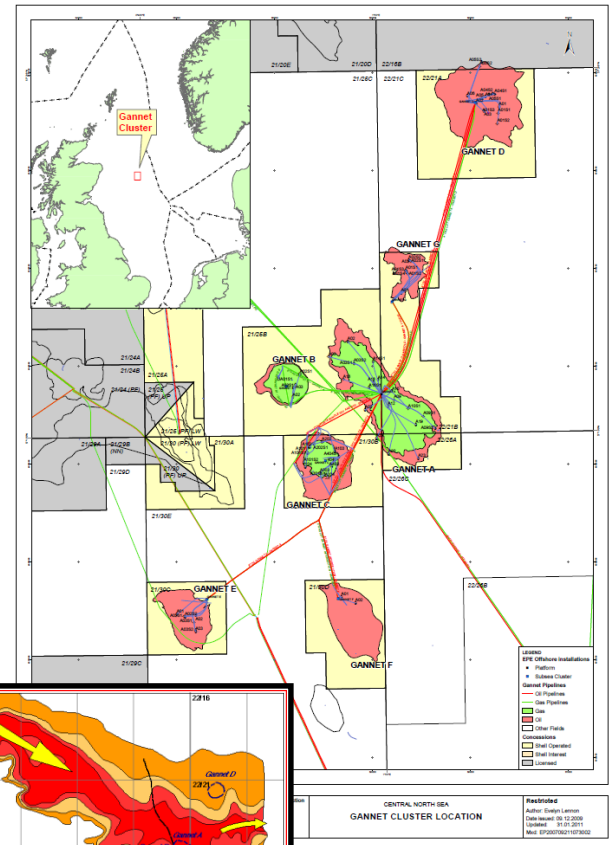
Summary & Takeaways

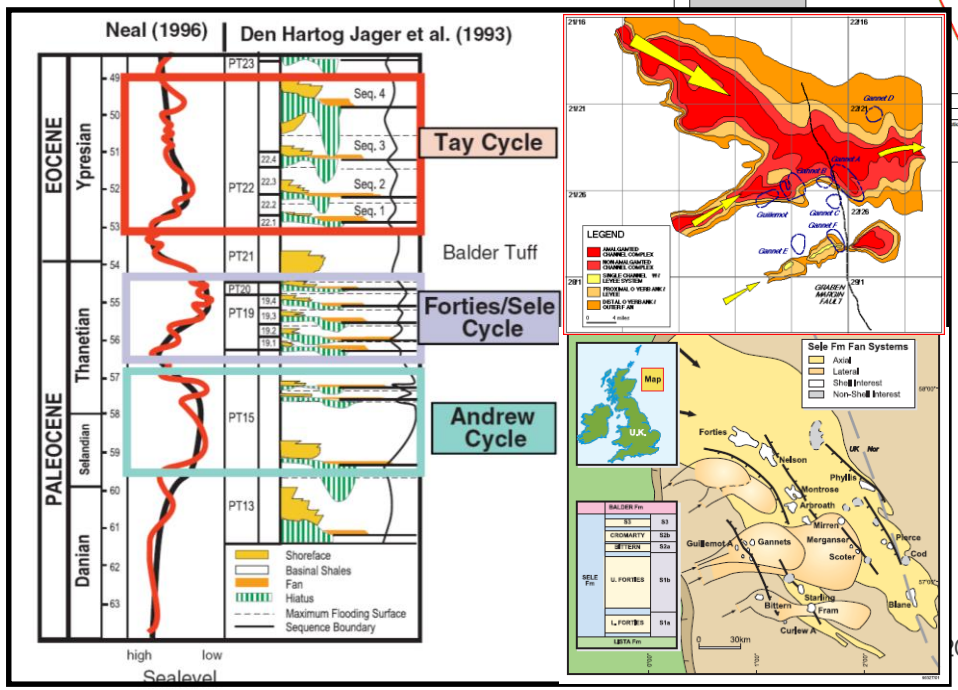


Gannet Cluster – Key Facts

Gannet cluster, history

- UK PL P.013 (Blocks 21/25b, 21/30b & d, 22/21a & b & 22/26a)
  - Awarded 1964
  - Discovered 1969 (Gannet F – 21/30-1)
  - First Oil 1992 (Gannet A-D), 1997 (E & F), 1999 (G)
- Cluster of 7 fields tied back to Gannet Alpha platform
  - Gannet A accessible by platform wells, all other fields subsea tie-backs
  - Gannet E now disconnected
  - Estimated Total hydrocarbons initially in-place: 1,200 mmboe
  - Total production to date *c.* 500 mmboe
- Palaeocene and Eocene deep water mass flow sandstone reservoirs
  - Andrew, Forties, Tay systems, with locally significant reservoirs in Sele and Balder Formations
  - Located above or around salt high features on edge of Western Platform or in the West Central Graben
- High quality reservoirs
  - Up to 90% N:G; 22-34% ø; 100's-1,000's mD K
- Powerful bottom drive aquifer in all fields (depletion of a few 100s psi over field lifetime)



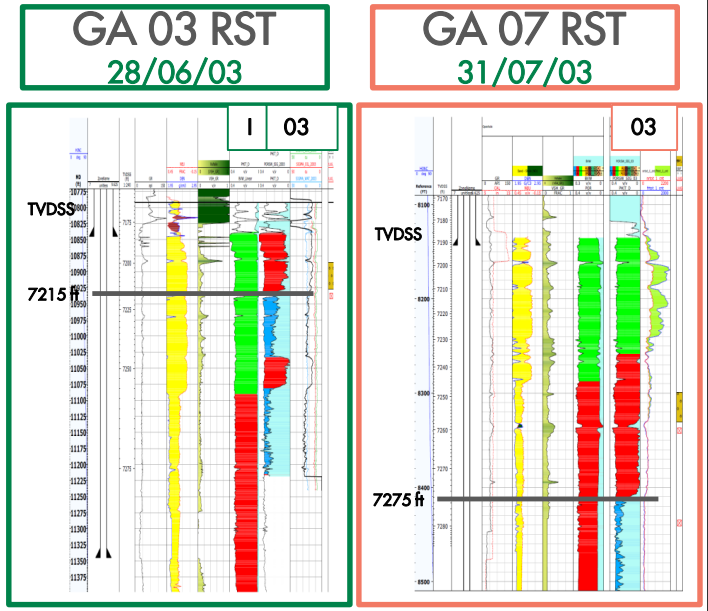


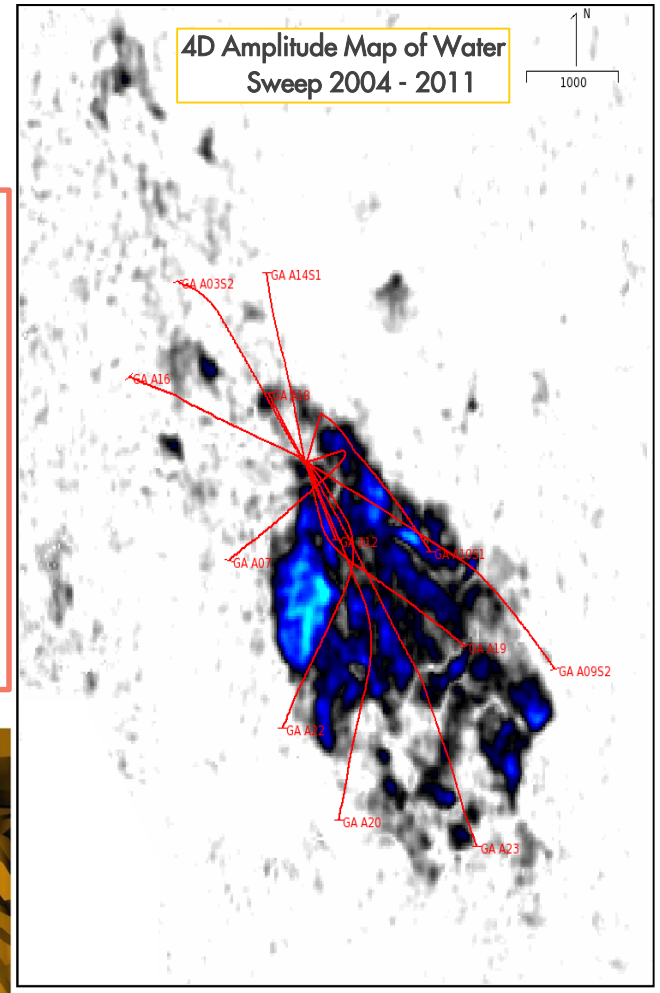
Gannet Alpha & DSV Seven Atlantic

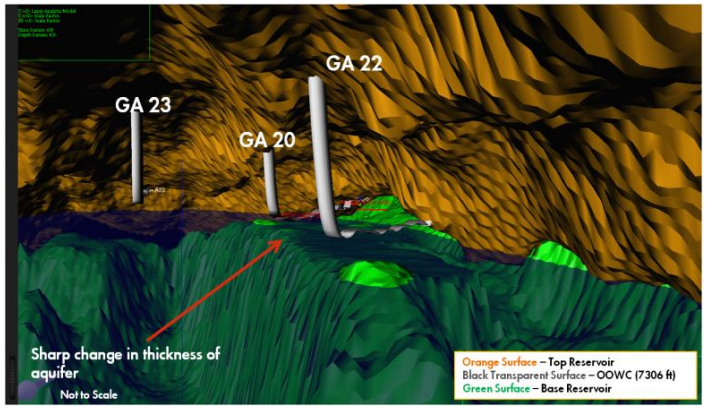
Building Confidence with Quick Wins

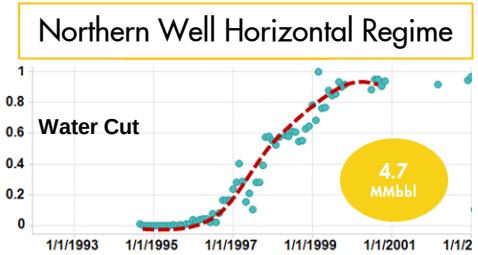
Know your field

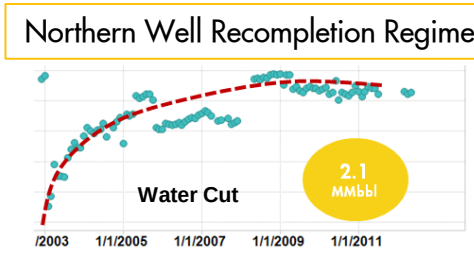
- 20 years of data collection put to good use
  - Contact tracking form RST/PLT logs
  - BS&W, WOR & GOR trend tracking from production data
  - 4D seismic data
- And know your geology
  - The Gannet A reservoir shales out to the south of the field
  - The geometry of the aquifer shields the south of the field from the bottom drive seen elsewhere.
  - Southern wells need a different WRFM strategy to optimise performance





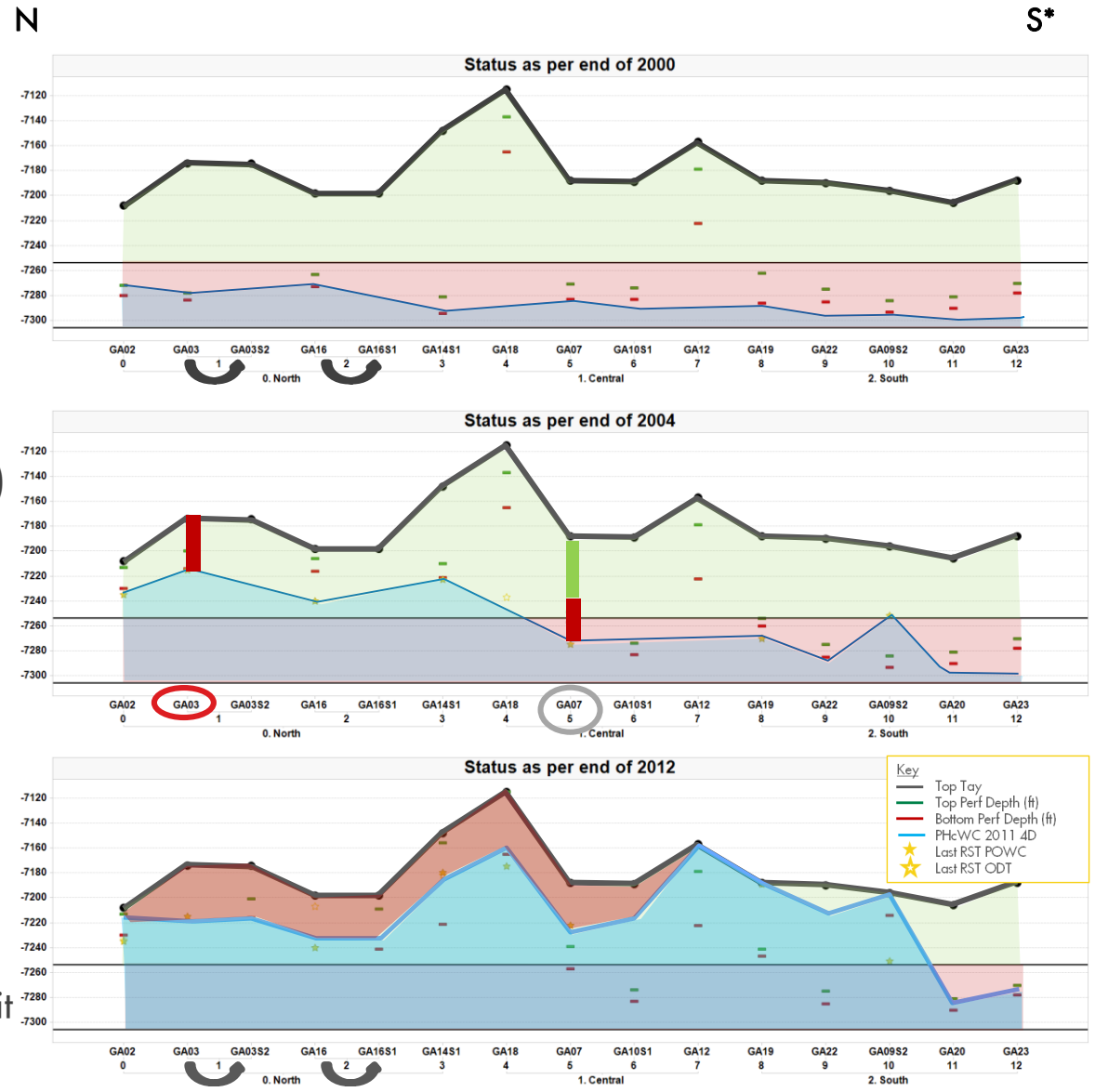






Know your field

- Combining this data allows for a simple but elegant representation of how Gannet A works
  - Initially all wells completed within oil rim
  - The strong aquifer, couple with gas injection intended to keep the rim in place
  - The geometry of the aquifer (shaling out under the field to the south) leads to a wave of water pushing the oil rim to the roof in the north and evacuating the gas cap to the wells in the south
- The present disposition of the contacts in the field dictate the style of intervention best suited to optimise production
  - In the north, complete the wells to the roof of the structure, shut off water from the original horizontal sections
  - In the south, preserve the horizontal sections as long as possible to drain the oil…
  - …while completing the upper part of the well to capture the gas as it flows past

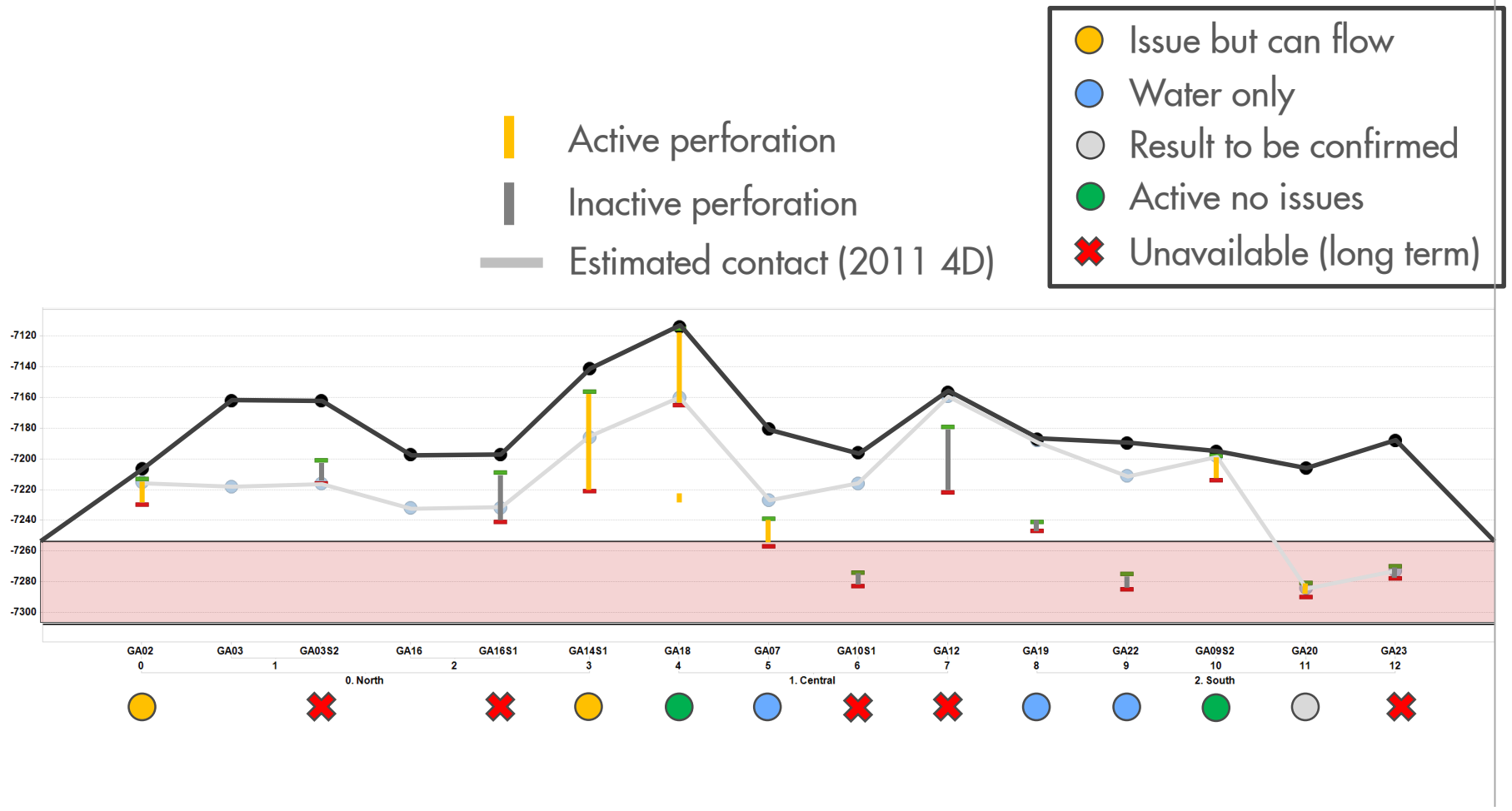


Understand and communicate risk

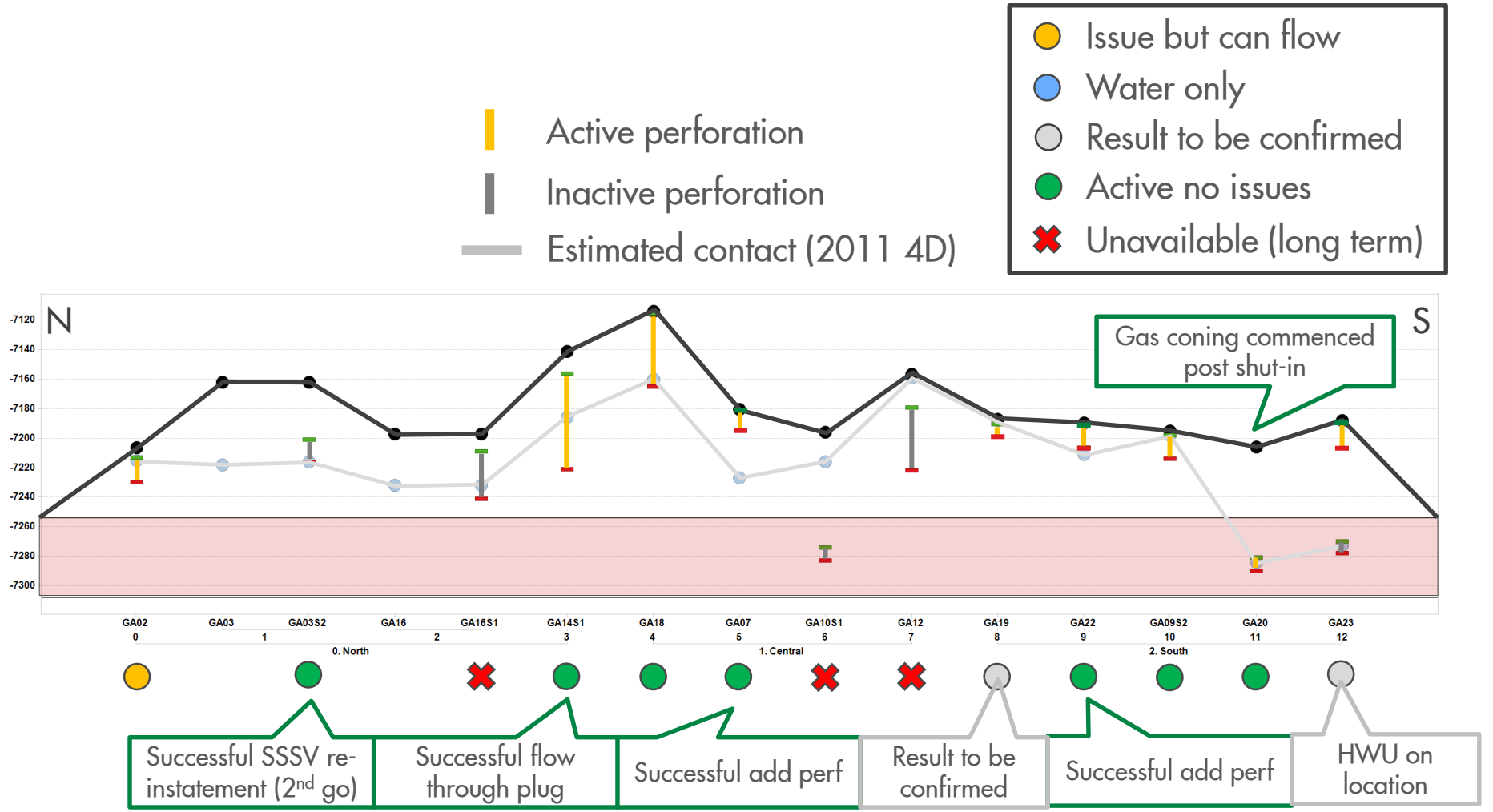
- Present opportunities with their *risked* gains
  - These are old wells you won't get everything right first time
  - So take the time to learn form those wells you don't fix, to improve the risking next time
- Batch together as a campaign to allow the upside from one well to compensate for any failures
- Delivering on your promises below budget establishes credibility and earns you the right to try again – including re-entering wells that you weren't successful with in this campaign
  - The Northern Well we failed to restore in this campaign was successfully re-entered 6 months later and is now one of our strongest producers

Well/Activity	Actual vs. Planned Cost (% diff)	Risked Initial Oil Rate (bbls/d)	Actual Initial Oil Rate (bbls/d)
Southern Well (RST & add perf)	+7.4	150	0
Southern Well (RST & add perf)	-44.4	870	1450
Mid-structure Well (RST & add perf)	-27.8	1660	1500
Southern Well Gas Lift Valve C/O (Integrity)	-13.1	NA	NA
Crestal Well (flow through plug – Safeguarding)	-68.2	350	750
Northern Well (SSSV – Integrity/restoration)	-39.4	640	0
Total	-28.5	3670	3700

Well status on restart (August 2014)



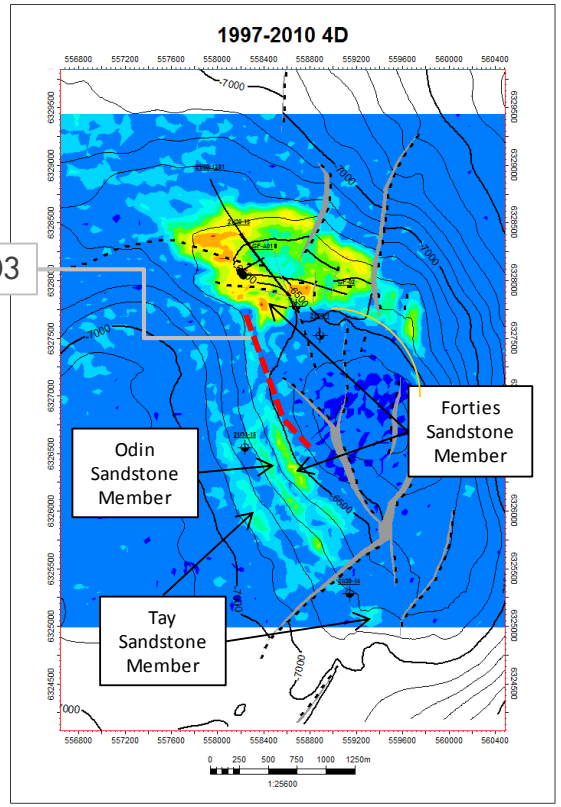
Well status today

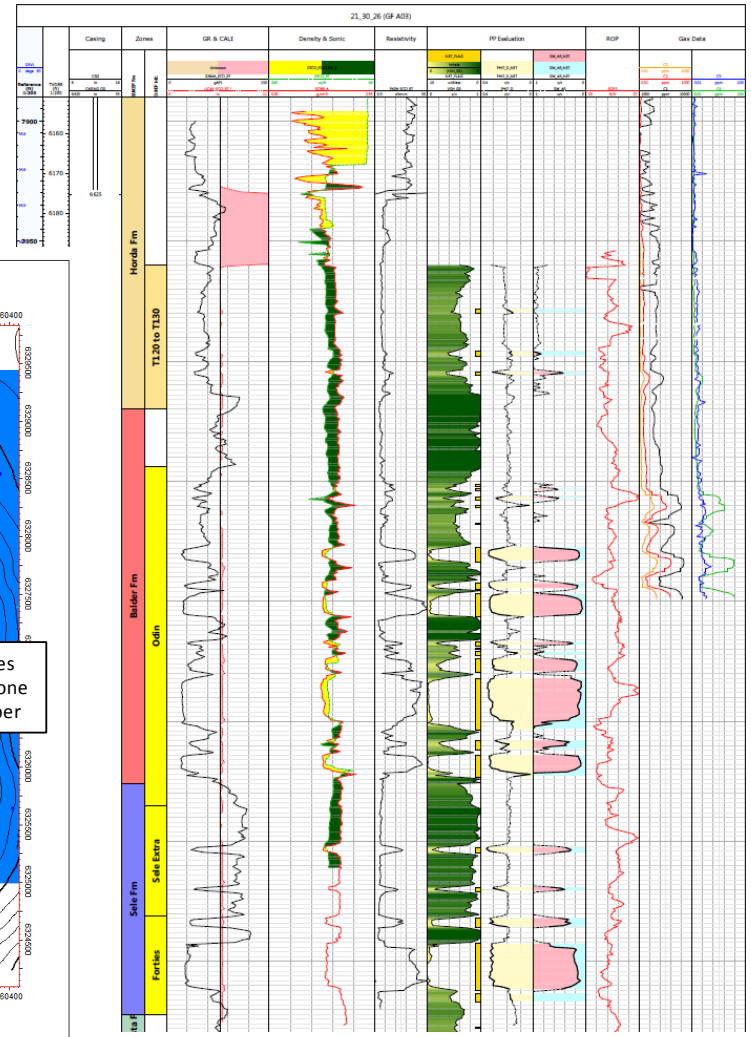


Success Breeding Success

Don’t forget about growth

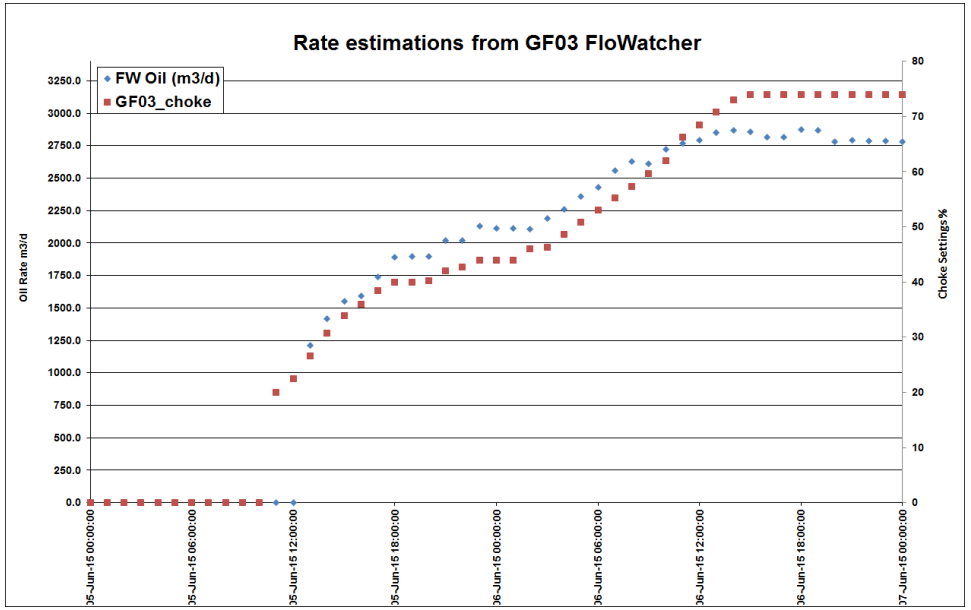
- Gannet still has an inventory of growth opportunities, some of which are quite material
- GF03 is a target that had been identified from the first Gannet F 4D survey in 2006
  - Production from Forties Reservoir in north only (GF A01)
  - 4D indicated saturation changes in three reservoirs – Forties, Odin & Tay – on southeast flank of structure, confirming significant movable hydrocarbons
  - Structural saddle between the accumulations meant significant volumes could be added by targeting area directly
- It was ready to spud in September 2011…

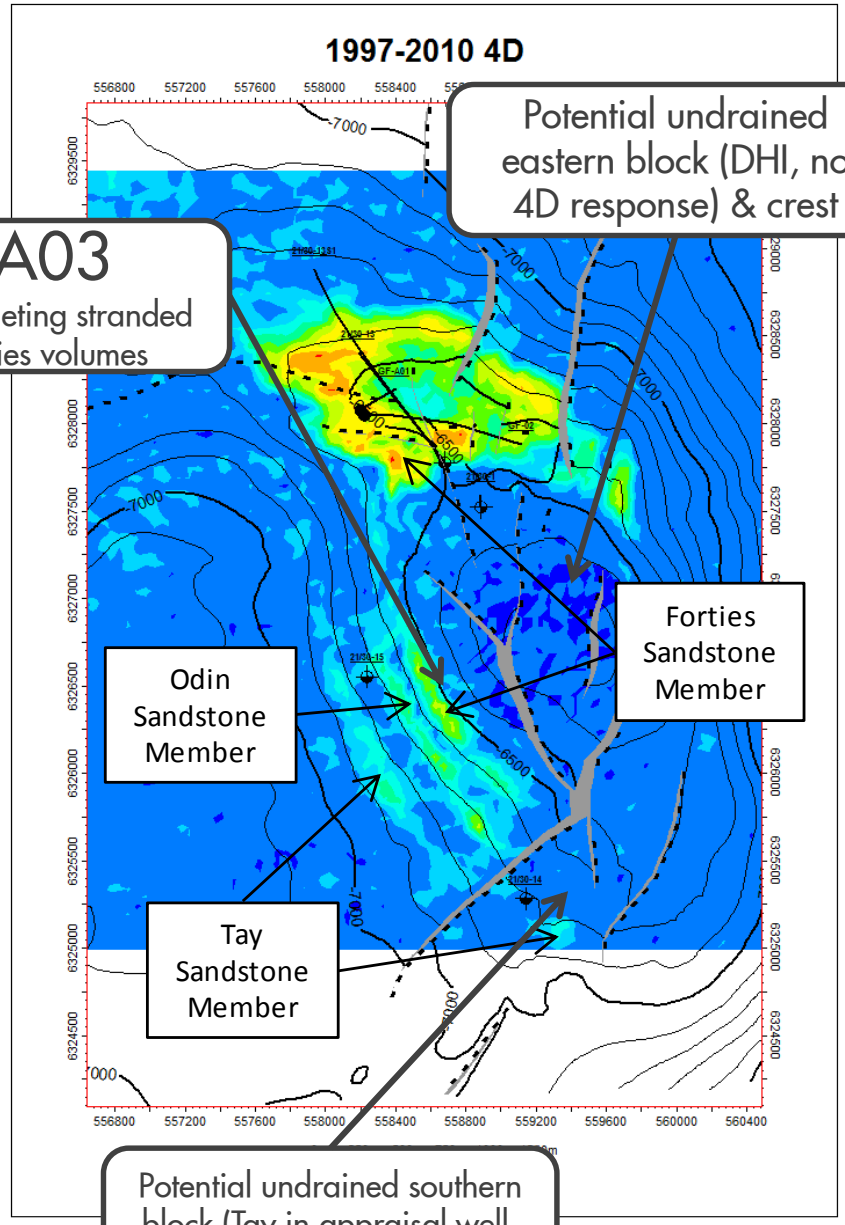




Don’t forget about growth

- …Eventually completed in April 2015
- The well came on at nearly 20,000 boe/d
- Has now produced 6 mmboe and only recently started to cut water
- Unsurprisingly, we are working up our other targets in Gannet F
- And we are planning to acquire a further 4D monitor survey this summer to see from where GF A03 has produced



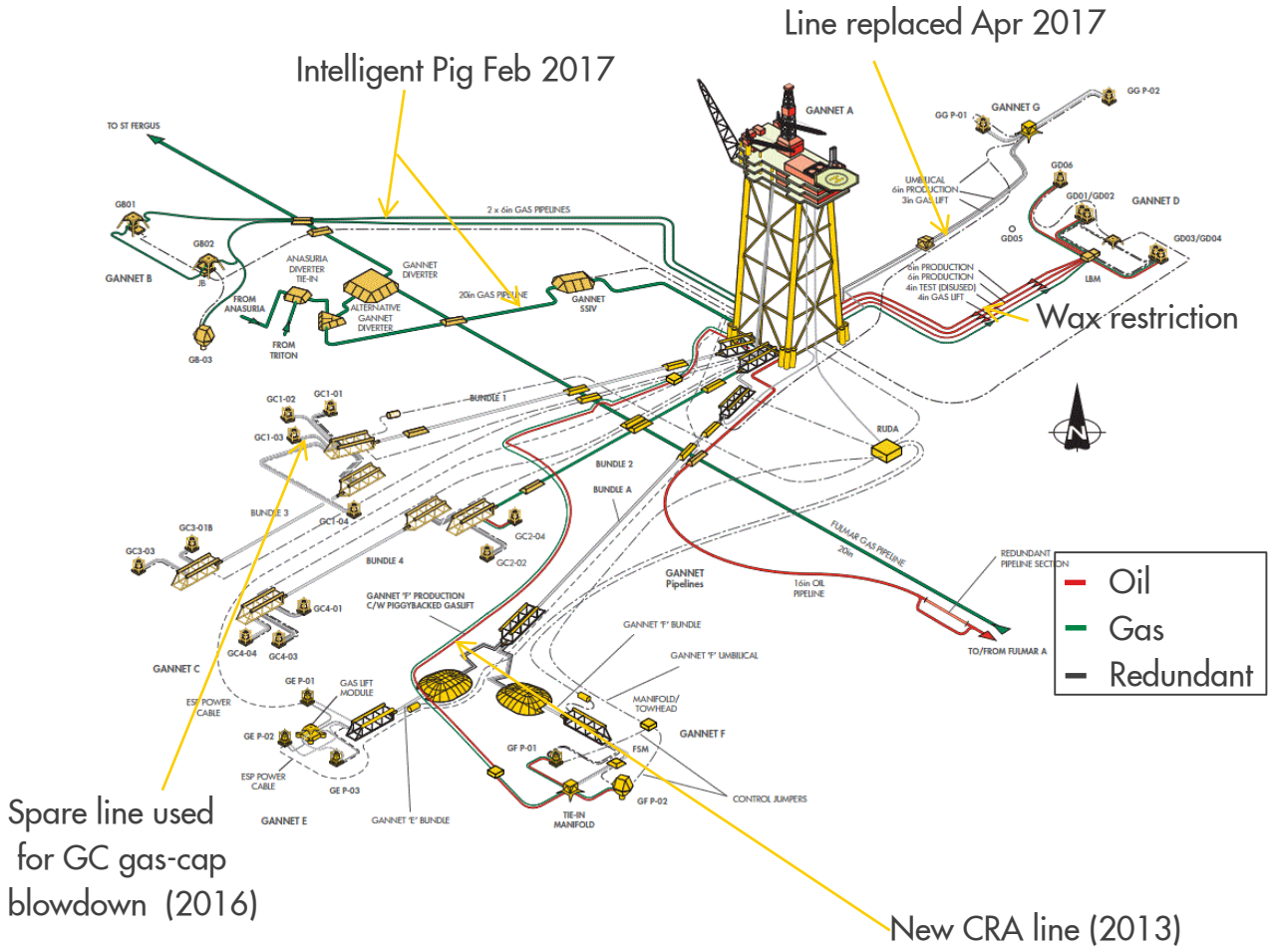


Gannet G: Loading flexible pipe into the underdeck carousel

Credible + Affordable = Achievable

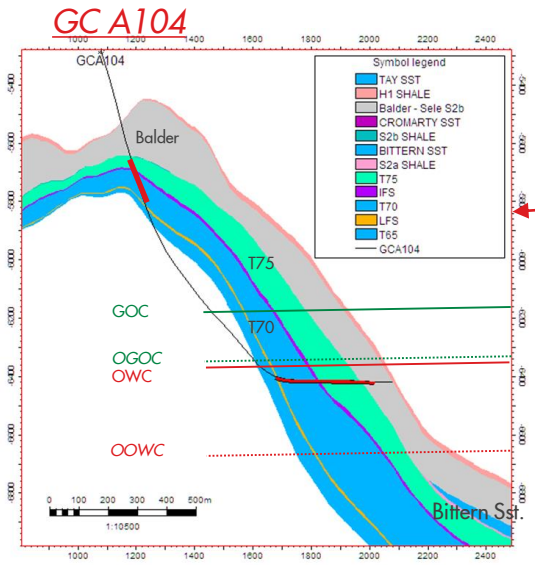
Gannet Subsea Infrastructure

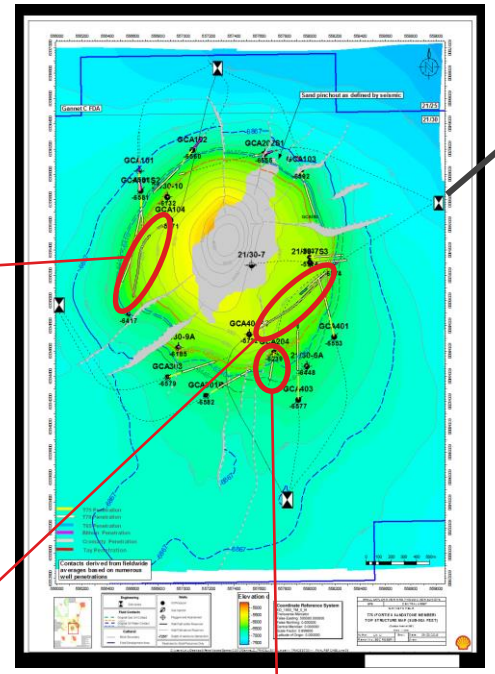
- Gannet F (Aug 2011) pipeline leak due to Preferential weld Corrosion (PWC)
  - When the leak was identified, production from all Gannet satellite fields with similar pipeline construction was shut-in (all but Gannet D)
- February 2013 – a pig was run through the oil export pipeline and became stuck behind a plug of wax
  - By-pass pigging had been in operation due to the known waxy conditions but was suspended due to low flow velocities (fields shut-in)
- To reinstate production
  - A new, corrosion resistant pipeline was installed to reconnect the Gannet F wells to the Gannet Alpha infrastructure (Nov 2013)
    - Gannet E, previously bundled in with Gannet F, was not reconnected at this time.
  - An11km section of the oil export line was cut out and bypassed (Aug 2014)
- Since process restart, a progressive pigging programme has been put in place with pigs being dispatched approximately every 10 days
- Once production restarted, further pipeline reinstatement projects could be initiated…

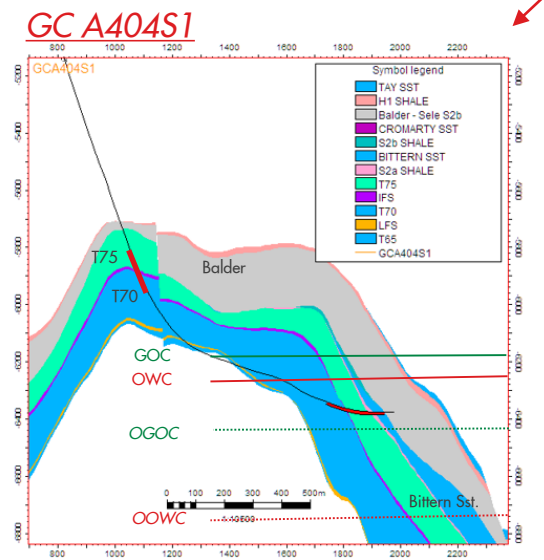


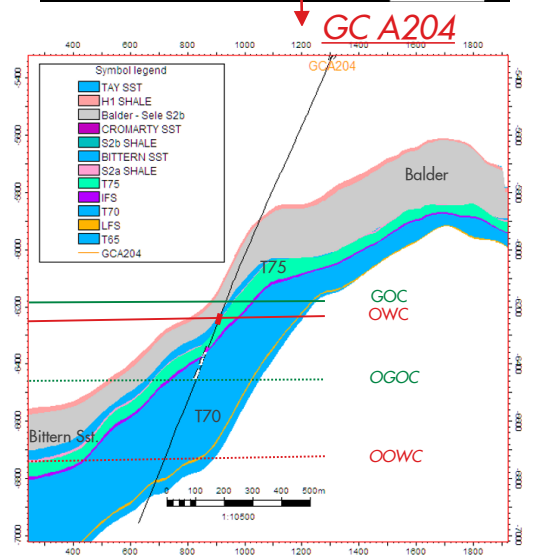
Gannet C Gas Cap Blowdown

- Original FDP included blowing down the gas cap at the end of field life
- 2 wells (GC A104 & GC A404S1) drilled for this purpose in 2006
- Other producing wells have gradually been drowned
  - Only GC A204 – originally a gas injector – still producing. 1 further well – GC A202 – a candidate for flow
- Project to add perforations to the two blowdown wells
  - Split into 2 phases to allow assessment of field connectivity
  - Use of competitive scoping reduced project cost to ~25% of the 2013 cost estimate
- Gannet C pipelines were all red-banded after the GF pipeline leak
  - GC A2 line pigged late 2015 to demonstrate integrity
  - GC A104 connected to unused gas lift line (although, also required to be pigged before could be brought into service)
- Production performance shows GC A104 is not producing gas from east of diapir so Phase II (add perf in GC A404S1) is being planned…



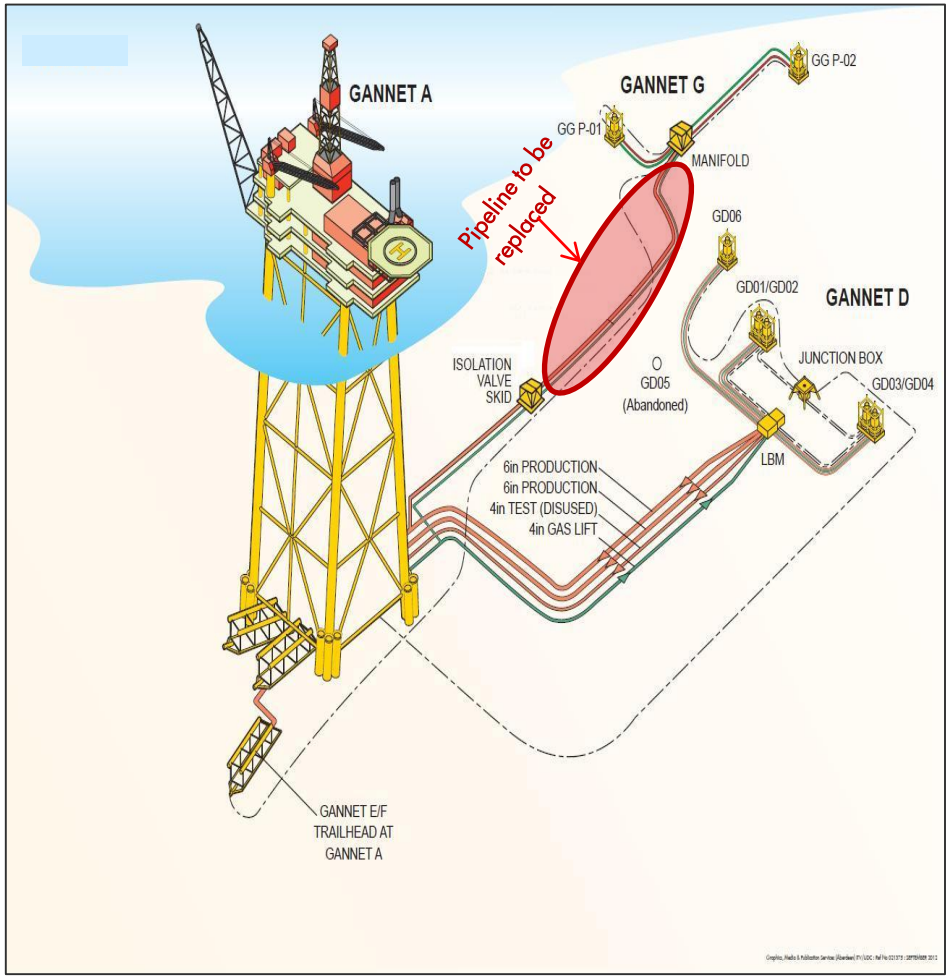






Gannet G Reinstatement

- Gannet G pipeline of same design as Gannet F.
- Taken out of service once Gannet F leaked
- To demonstrate integrity would require subsea pig handling capacity
  - This additional cost, coupled with an expectation that the pipeline would most likely need to be replaced meant that project was deemed to be unattractive
- Post oil-price downturn, reviewed options
  - Assumed replacement as base case – removing cost of subsea pigging
  - Selected 6" flexible pipeline as replacement
- Project planned for <25% of 2013 cost estimate
  - And was delivered under budget and ahead of schedule
- Field came back online 20th April 2017



Summary & Takeaways

- Make a commitment
- Build credibility
- Don't forget to grow
- Affordable, credible…achievable
- Gannet has a future, and it is full of value restoring/adding projects
  - Gannet B restart
  - Gannet F 4D and further wells
  - Gannet D restart
  - Gannet C blow-down, phase II…

The author would like to thank Gannet partners – Shell U.K. Limited and Esso Exploration & Production U.K. Limited – for their permission to present this work and Gannet team members past, present and future for their contributions

Shell U.K. Limited