

Galapagos Development – Phase 1

Key Well Technologies – Smart Completion

July 2019



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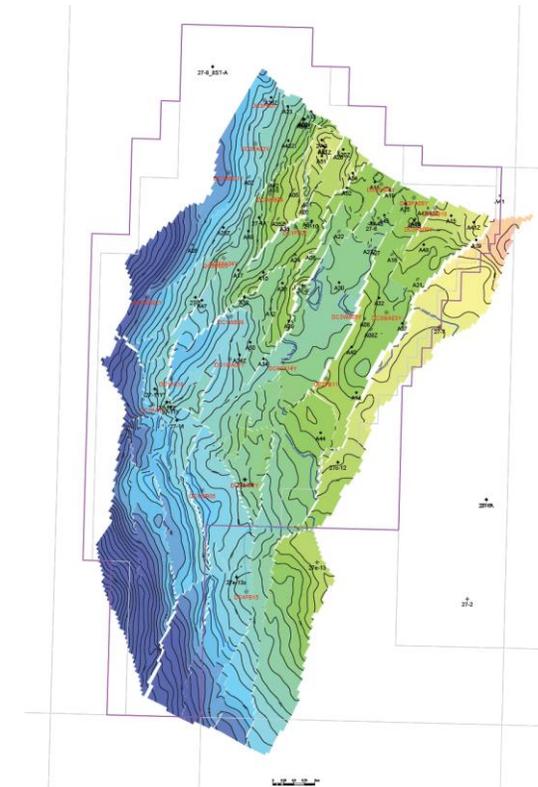
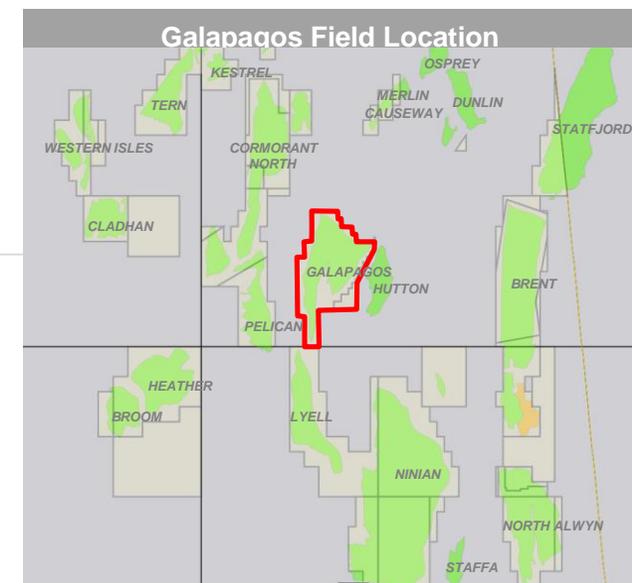
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NNS Redevelopment Opportunity

The largest under-developed conventional field in the UKCS

- Bridge Petroleum Limited (Bridge) is undertaking the task of re-developing the Galapagos field (previously NW Hutton and Darwin fields), believed to be the largest underdeveloped field in the United Kingdom Continental Shelf (UKCS) and one of the largest remaining fields yet to be developed outside the West of Shetland region. **Recent CRP by ERCE booked 80.1 mmboe 2P reserves for Stage 1 (of 3 planned)**
- The Galapagos field is an extensive field surrounded by a cluster of giant fields that make up the Brent system in the UKCS. The geology is proven, prolific and well-understood in the UK oil & gas industry. The field location also allows for significant upside potential from further developments of smaller fields and partly depleted resources in the region.
- The Galapagos field development comprises the following components:
 - **The Galapagos Stage 1 Development** is the focus of this presentation and farm-out process. This development is focused on accessing the known prolific compartments of the Galapagos reservoir to provide low-risk returns in a short-timeframe.
 - **The Galapagos Stage 2 Development** focuses on the southern region of the Galapagos field. Consideration as to precisely how to develop these resources would be for the future partnership to refine;
 - **The Galapagos Stage 3 Development** represents further upside potential as part of the Stage 2 development, including infill.



Lessons Learnt

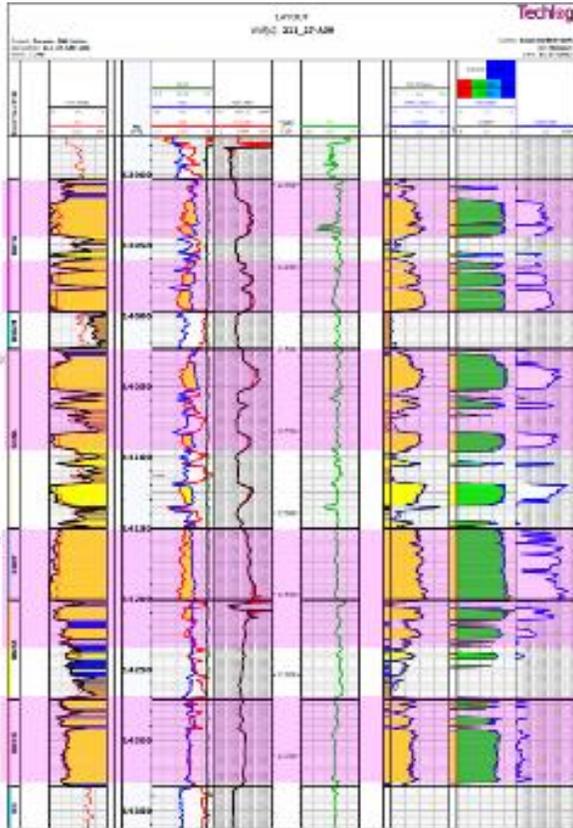
Redevelopment of Galapagos

Past Operators	Historical Issues and Learnings	Addressed by Bridge Team	Work performed
 <p>1975 - 1998</p>	<ul style="list-style-type: none"> 1970s seismic and drilling technology Poor definition of faulting Single drilling centre – tortuous well paths and many stuck tools Poor handling of scale formation (many interventions) 	<ul style="list-style-type: none"> High definition of seismic – clear definition of faults and top Brent surface Simple well trajectory with long lateral reach Multiple drilling centres Scale management strategy 	 <p>2017 - Present</p> <ul style="list-style-type: none"> Full production history matching by wells, compartments and field – first time Apply well control technology – production and injection Maximise reservoir coverage by horizontal / slanted wells Phased development approach to optimise cash flow Conservative planning and estimates Focused team with involvement in Galapagos field for 10 years Alignment with supply chain to develop and operate the asset Potential for Phase 1 acceleration
 <p>1998 - 2009</p>	<ul style="list-style-type: none"> Short spacing between injector-producer (~200m) Short circuitry – thief zone (poor WI program) Cullen report required massive infrastructure upgrades Low oil prices ca. \$9/boe, COP with 67-90mmbbl remaining reserves (NFA scenario) Topside and HSE challenges 	<ul style="list-style-type: none"> Down-dip injectors with >1km spacing Determined water behaviour (thin channels/thief zones) New infrastructure or hubbing, incorporating lessons learned Remaining reserves ca. 140 MMbbl Conservative development stage 1 recovery factor of 24% Conservative estimate, up to 30% recovery for stages 1 and 2 	
 <p>2009 - 2013</p>	<ul style="list-style-type: none"> Focused on delineating field Modelled whole field Members of BPS/SVT - legacy ~£15/bbl extra tariff Prioritised capital allocation on other asset FIP3 focused in the initial re-development plan 	<ul style="list-style-type: none"> Focus on early cash flow from previously produced prolific compartments Modelling compartment by compartment history matching Self-contained export route (FPSO) via tanker or SVT (new low tariff) Investment allocated from start of project 	
 <p>2013 - 2016</p>	<ul style="list-style-type: none"> Farmed in to drill wells in the south Utilised simplified analytical forecast (latest seismic and G&G work not included) Members of BPS/SVT consortium - ~£15/bbl extra tariff Capital allocation prioritised in other assets and non-operator partners unable to commit own resources. 	<ul style="list-style-type: none"> Focus on cash flow from Northern compartments to redevelop the whole field New diagnostic and forensic work diversify export route via tanker (FPSO) and via SVT (lower tariff) Investment not deployable elsewhere Analytical, mass balance and numerical history matching/forecast 	

Water diagnostic plot

What data is needed for a basic analyses?

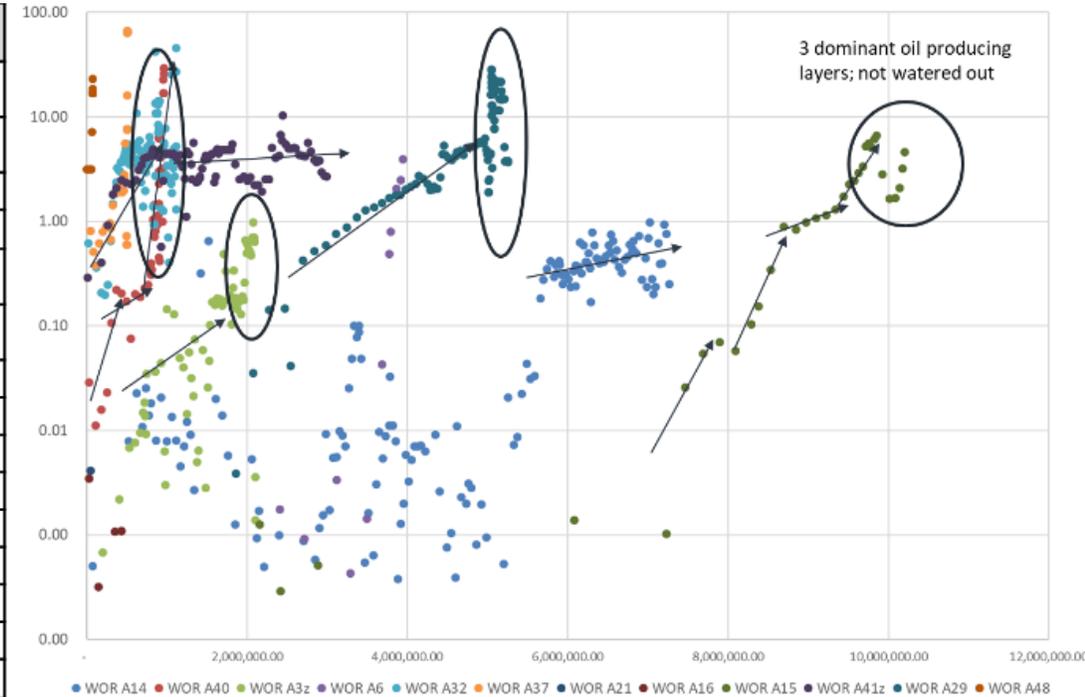
CPI logs



Multiple PLTs (or layer production allocation methods)

Perforated Interval ft MD RKB	Layer Number	Zone	PLT 1 (%) 07/11/84	PLT 2 (%) 21/08/85	PLT 3 (%) 24/08/85	PLT 4 (%) 06/03/88
13114-13136	1	Upper Marine	24.7	21	19	23.2 (19.3%O:80.7%W)
13172-13200	2	Upper Coal	7.5	8	10.1	23.3 (24.2%O:75.8%W)
13204-13208	3	Upper Coal	-0.4	0	8.3	0
13231-13241	4	Upper Coal	17	14	9.7	29.1 (6.5%O:93.5%W)
13260-13269	6	Upper Coal	9.8	11	3.9	24.3 (21.5%O:78.5%W)
13277-13290	7	Upper Coal	23.3	26	25.2	44.2 (19.3%O:80.7%W)
13320-13342	8	Lower Coal	11.5	16	11.6	0
12250-13360	9	Lower Coal	-2.9	0	0	0
13379-13387	10	Lower Coal	0	0	0	0
13410-13421	10	Lower Coal	9.5	0	1.9	0
13433-13481	11	Massive	0	2	9	0
13492-13505	12	Micaceous	0	0	0	0
13556-13570	13	Basal	0	0	0	0
13582-13588	13	Basal	0	2	1.3	0
Stabilised Rate (bpd)			4,719	5,458	5760	3,270

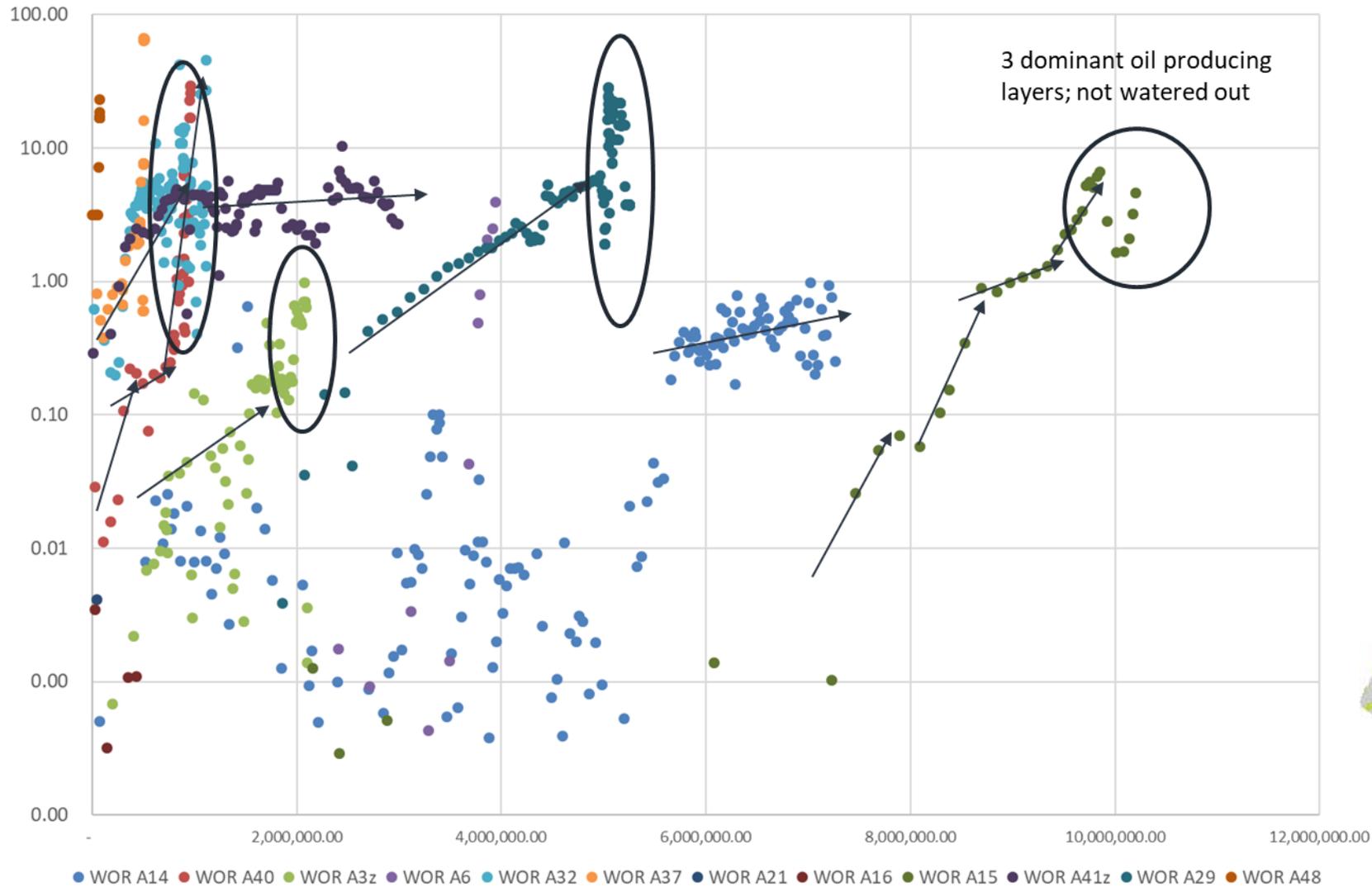
Analytical – WOR' vs cum



Forensic analytical work was conducted to understand the historical issues related to water behaviour. This combined the use of a derivative Chan Plot, available well PLTs, producer-injector pairing evaluation, well logs and well production and operational reports. Streamline modelling, provided there is sufficient confidence in base data is also recommended

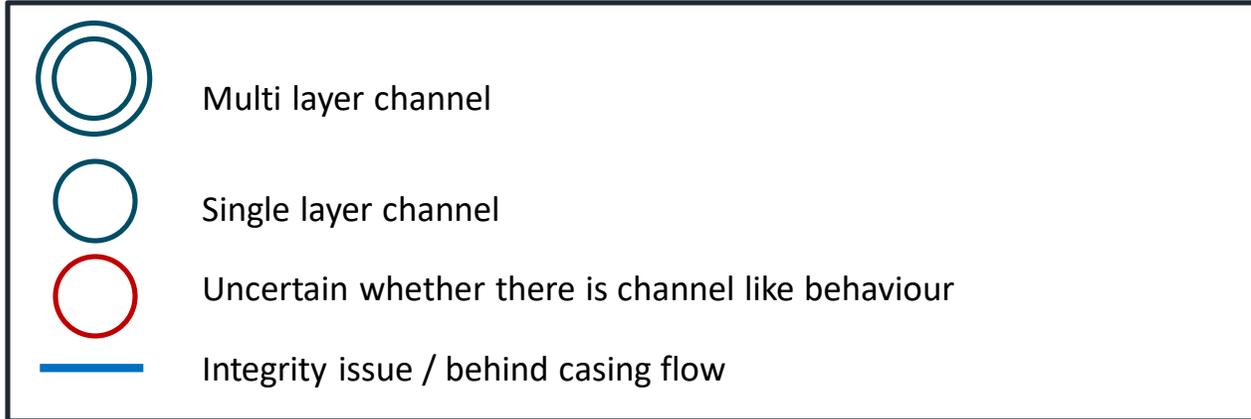
Galapagos Eastern Terrace

General FIP 3 Wells – Water Diagnostic Plot Analyses

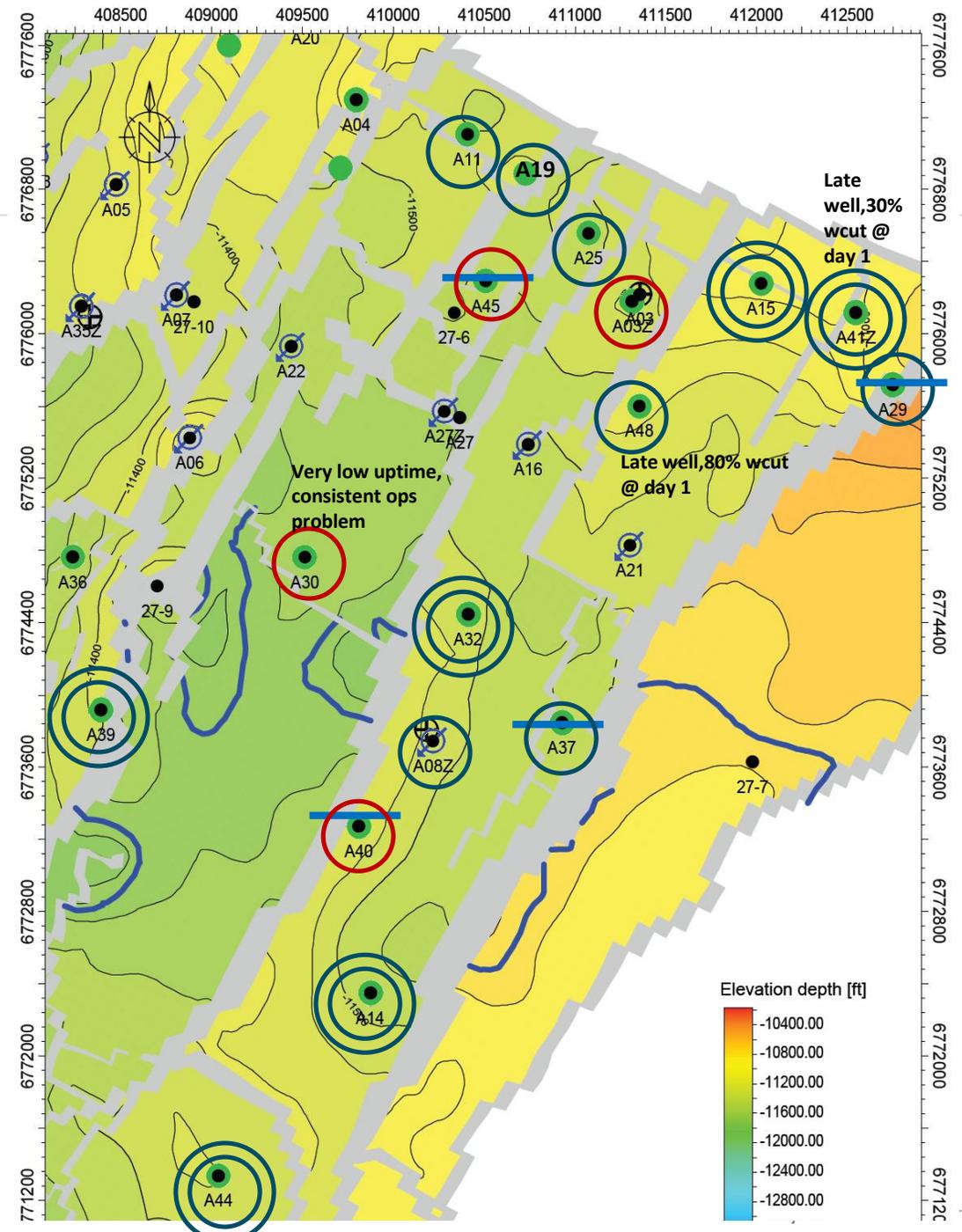


Production View

Summary water behaviour FIPs 3 & 4 – Mapped Out



- Channel behaviour evident - FIP 3 and FIP4
- Bulk or all of water produced in the producer wells are from these high perm conduits / channels
- Causing lifting issues and likely crossflow;
- Meaning that the main sands have been poorly flooded and minimal pressure support



Legacy Production – Fieldwide View

Poorly managed water injection resulted in poor production (well by well analyses)

Water Breakthrough Analysis

Water Issue	Number of wells	FIP3	FIP4	FIP5	FIP12	FIP13	FIP14	FIP15
Edge water/Channel flow	33	8	5	0	4	7	6	3
Conduit behind casing	8	0	1	0	0	1	2	4
Watered out layers	8	1	1	0	2	1	3	0
No useful deduction	21	5	2	2	3	3	0	6

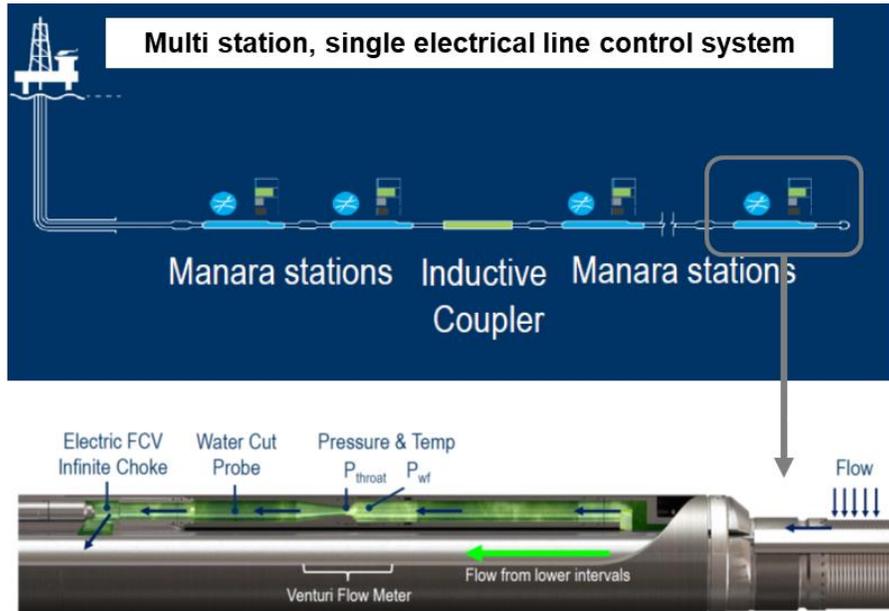
Observations:

- The bulk of water production is from preferential sands (channels), with some likely watered out;
- Other (main) sands are likely poorly swept;
- Injection deviates from Darcy meaning that water front are greatly influenced by channel system in Ness (zonal control required in both injector and producer), and likely near wellbore impediment. With the benefit of hindsight, zonal injection is key for the different Brent sands, and selected sub sands;
- Several wells experienced integrity issues which could be repaired;
- Several wells experienced lifting issues due to unavailable gas lift injection (not reported here);
- Several wells were shut in prematurely either due to tools being stuck or wells producing below expected PI resulting from scale deposition.

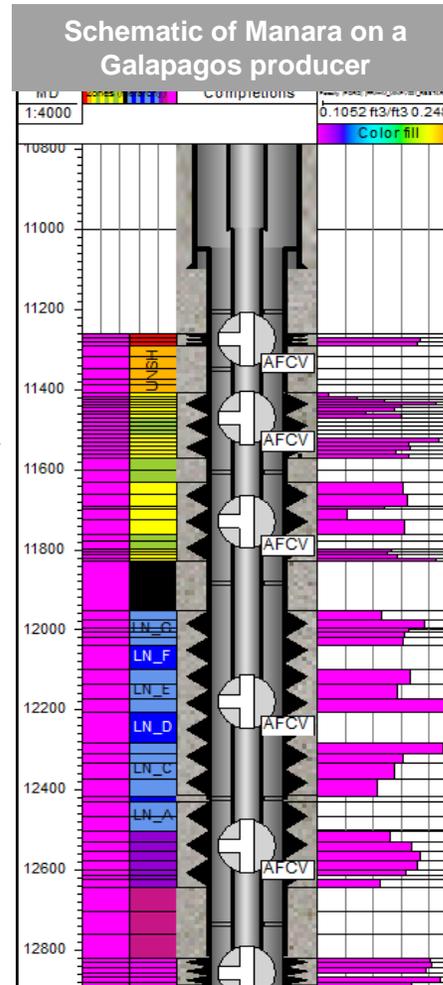
Galapagos Field – Unlocking value through current technology

Multistation ICVs unlocks reserves through zonal control

The illustrations below reflect the schematic of the Manara ICV and a summary of its functionality.



- | | | |
|---|--|---|
| Simple | Efficient | Flexible |
| <ul style="list-style-type: none"> 60 stations, 1 line | <ul style="list-style-type: none"> RT closed loop control 'Dial-a-rate' & 'Maintain-a-rate' 5 minute choke activation | <ul style="list-style-type: none"> Flow and pressure Water cut Infinite control All located at the sandface |
| Robust | | |
| <ul style="list-style-type: none"> 520 validation & verification tests | | |



Installation to date:

- 24 systems installed;
- ERD, ERC and multi zone wells.

Planned installation:

- 2 x 6 zones ERD (Sakhalin);
- 3 x 6 zone ERD (Astrakhan);
- 2 x ESP Wells (Ecuador);
- 5 wells on multi zone installation for 2018 delivery;
- Several North Sea fields are planning for installation pre 2020.

Value

- Multi zone control for wells is required for injection – production management;
- Real time data acquisition – non intrusive;
- Zonal water management, including indirect management of potential induced souring, scale and total volume of water;
- More efficient VRR than otherwise – reduction in total volume of water injected and produced = less waste.

Application

- Manara system ICV is planned for all producers, 5-7 stations per well;
- Proteus – a precedent technology to Manara is planned for all injectors, 5-7 stations per well. Injectors are planned with Proteus to allow injection rates to be maximised as required.

P50 Development Optimisation

ICV/OCV optimisation illustrates the value of zonal control

FIP3 Only Example		Historic Production			Non Optimised		Partial Optimisation WECon		Full Optimisation ICV
		STOIIP	MMbbl	RF (%)	MMbbl	RF (%)	MMbbl	RF (%)	MMbbl
FIP3	Base Case	170	41	24%					
	P50	182	41	23%	17	32%			22

Using FIP3 as an example, a shallow terrace with good properties.

- The P50 history match model shows a 23% RF;
- Without ICVs, the P50 development case achieves 32% RF, an incremental 17 MMbblo.
- With full optimisation, the ICVs P50 case achieves 35% RF, an incremental 22 MMbblo.
- This highlights the value of ICVs which is aligned with regional MER view;

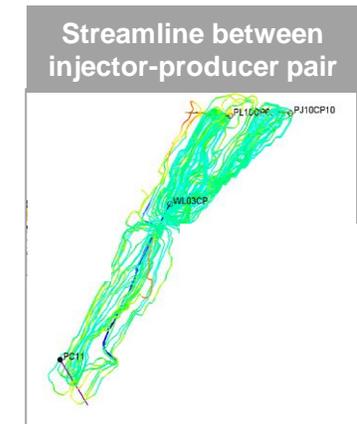
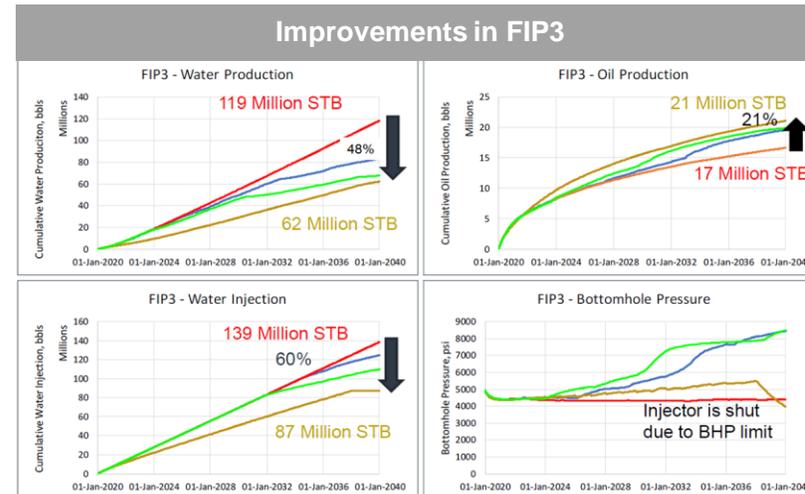
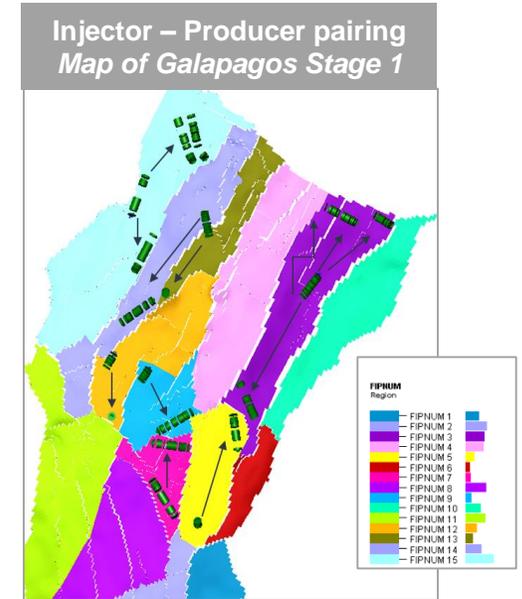
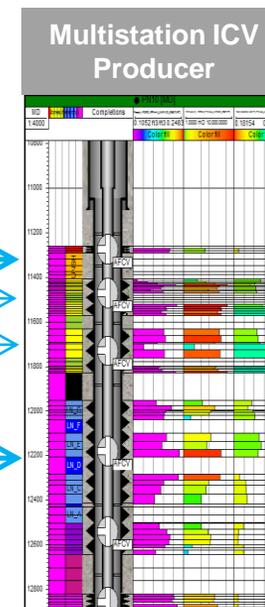
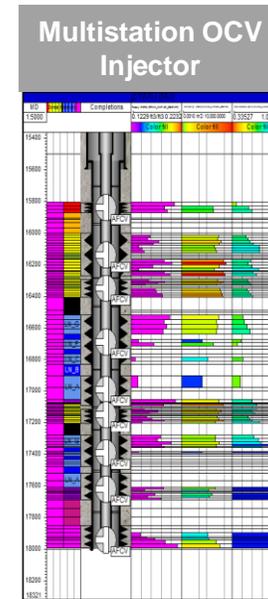
But its not just about oil...

Good for oil recovery...

But not just oil....

Good for oil, but not just oil:

- Available technology today
- Better oil recovery
- improved water management where thief zones are prevalent (volumes and injectivity)
- Frequent and consistent data acquisition
- Flow assurance control (arrival temperature control)
- Scale management (volume, mixing)
- Topside sizing / selection (cost and availability)
- Host option and selection (cost and availability)



Galapagos learning

Its not just about oil.... For impacts MER on costs (water, processing, flow assurance, host)

- Available technology today - ICVs can be used to manage thief zone provided vertical compartments are sufficiently available
- Multiple sources of data are needed to conduct water analyses; using 1 method alone is not sufficient
- WOR' is a powerful tool for brownfield analyses; recent paper by Apache (Tony Peters on Janice at DEVEX 2019) further confirms this
- Its very important to collate well data as frequent as possible, however,
- Its becoming irrelevant to have to intrusively access the well for data acquisition as the cost basis has substantially increased compared to commodity price
 - Smart completions therefore presents the opportunity for:
 - Better oil recovery
 - improved water management where thief zones are prevalent (volumes and injectivity)
 - Frequent and consistent data acquisition
 - Flow assurance control (e.g. arrival temperature control)
 - Scale management (volume of water, mixing zones, ion stripping)
 - Topside sizing / selection
 - Host option and selection



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