Hydrogeology of the Dry Creek Salt Fields and Groundwater Flow Towards the Mangroves of St Kilda

Presentation for 25 May 2021, NGO Meeting

Principal Mining Assessment Officer, DEM

SOUTH AUSTRALIA

Government of South Australia

Department for Energy and Mining

Objectives

Update on:

- Groundwater heads and salinity along Transect A
- Groundwater flow and salt flux towards the marsh

Everything presented today is preliminary and draft and represents work in progress

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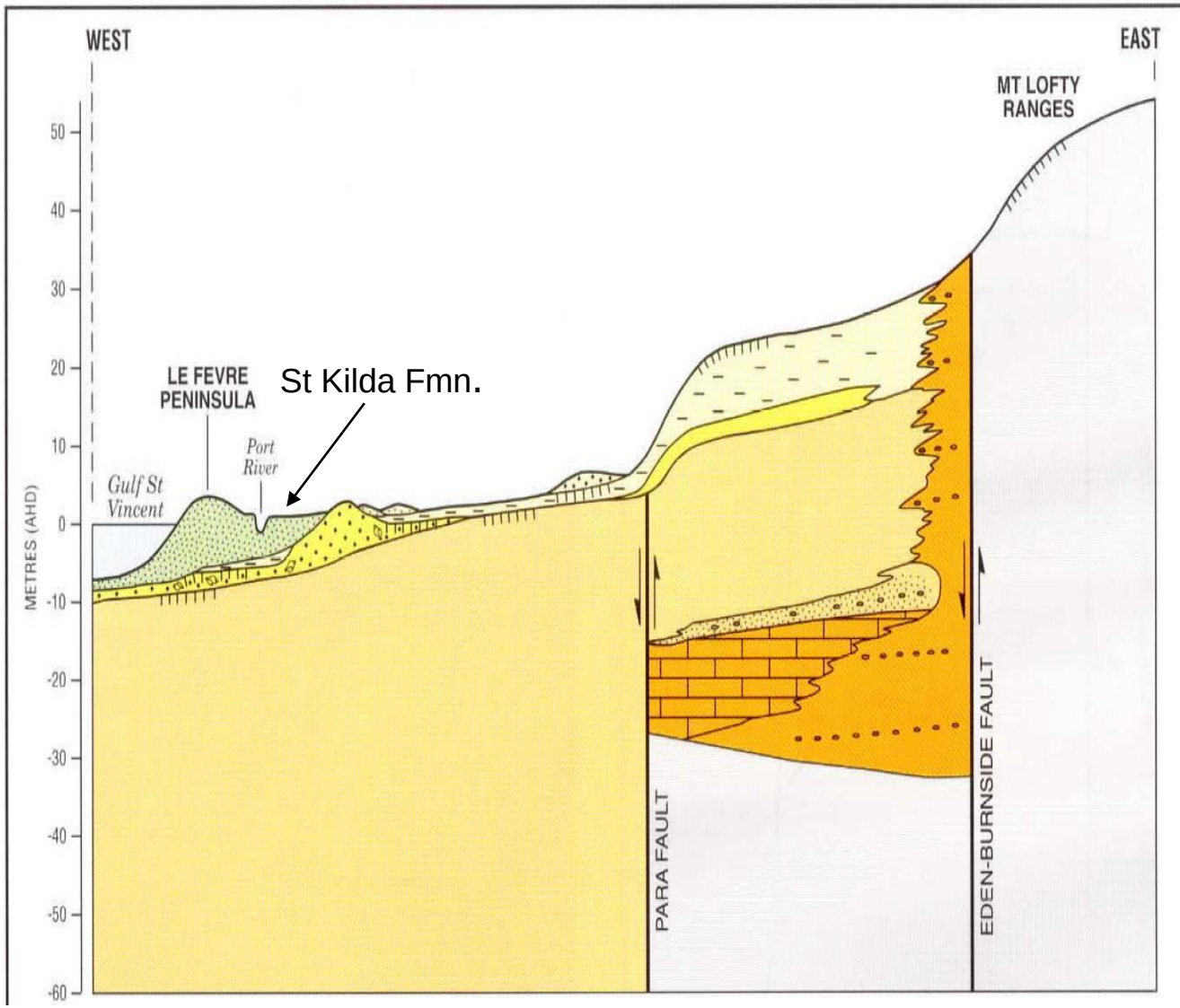
Reminder: Geology and Hydrogeology

Pre-salt fields:

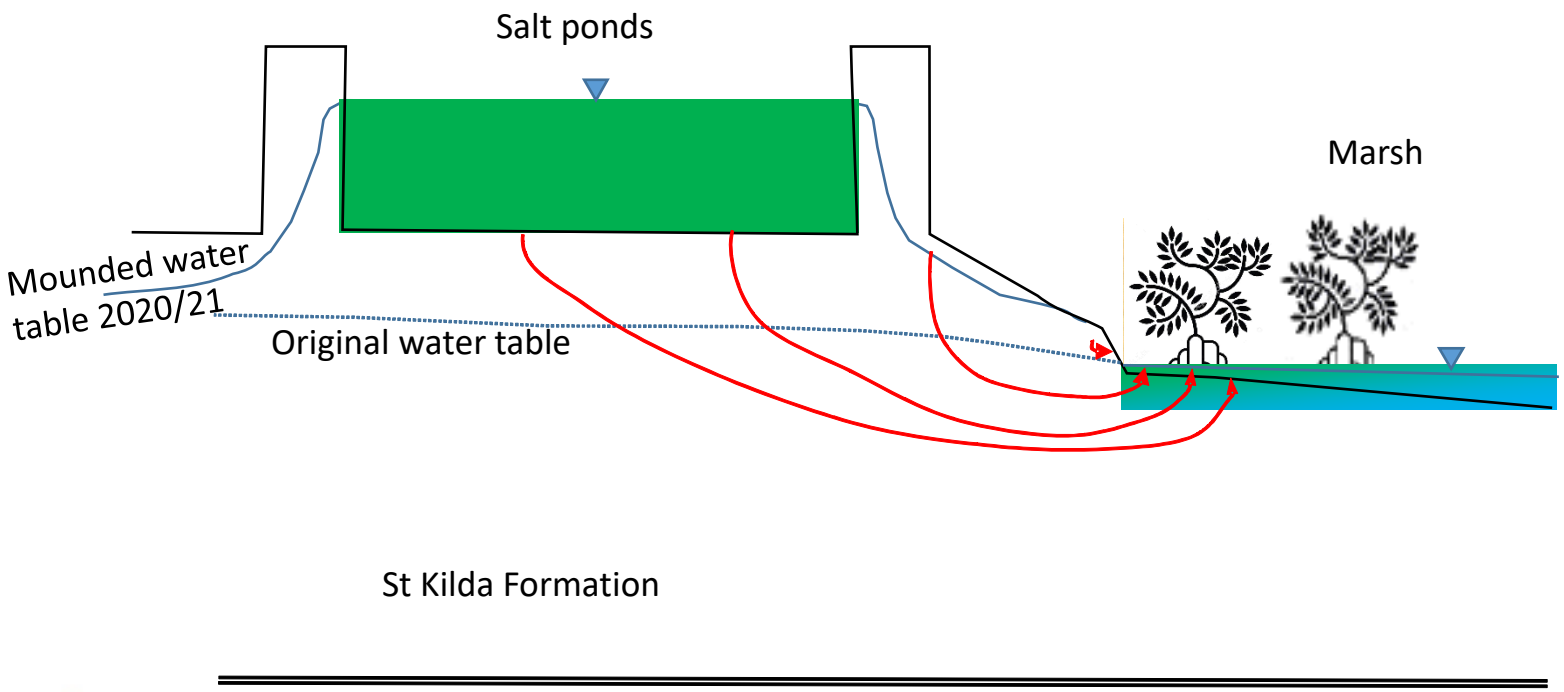
- Thin (<4m) coastal aquifer in the St Kilda Formation
- Horizontal hydraulic gradient towards the west
- Water table close to ground, some waterlogging in winter
- Groundwater discharge to the marsh
- Thin aquifer, water table close to ground = not much space left for extra water

Salt ponds would have changed the hydrogeology:

- Leakage creates an artificial groundwater recharge that can form a '*mound*' beneath the pond.
- Due to the elevated position of the mounded water table, there will be an increased groundwater flow to the marsh (and also towards the eastern landward side of the pond) with increased salinity.



Reminder: conceptual hydrogeology



Mounding causes more salt flux

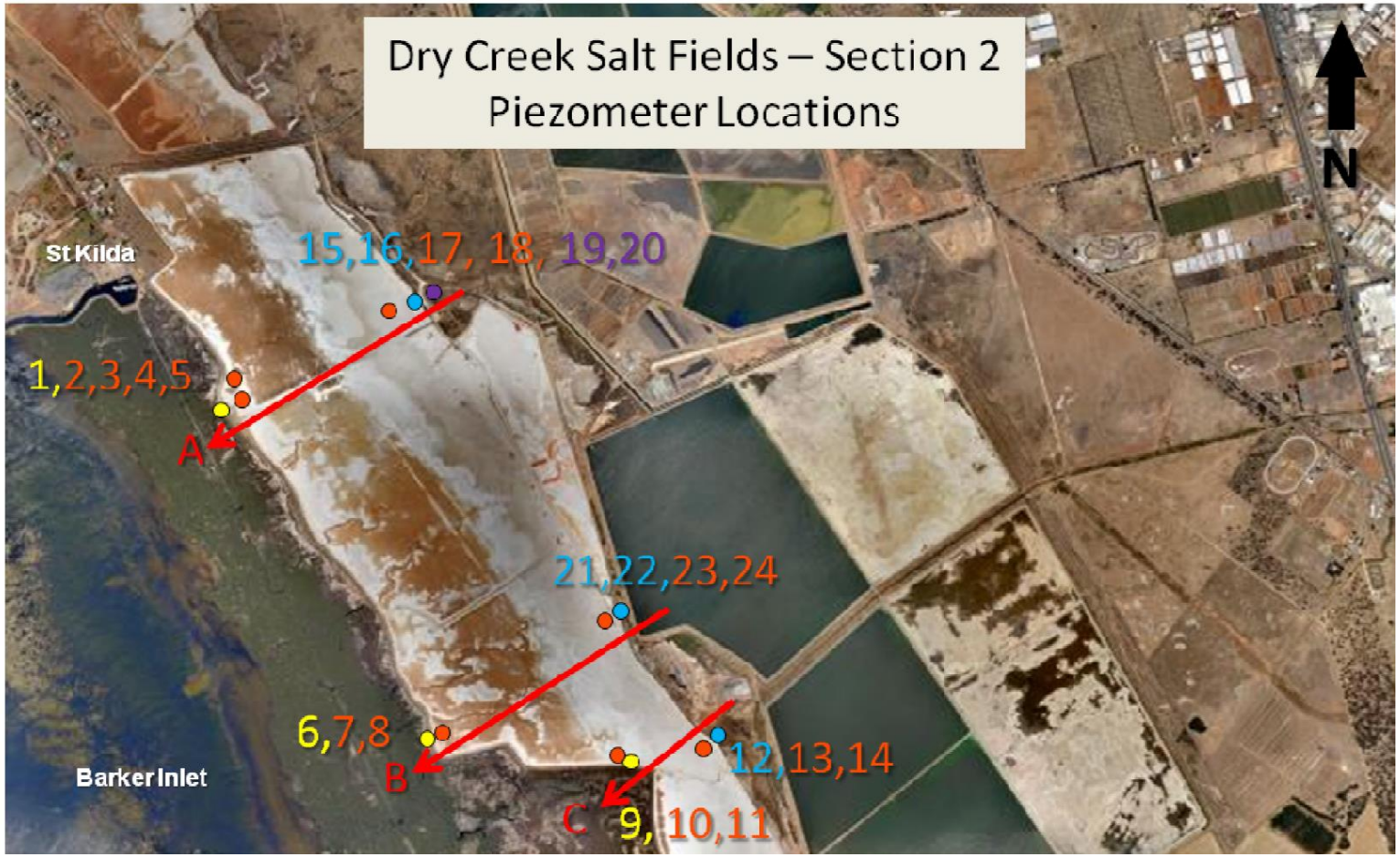
- **Cracked gypsum bed** → increased hydraulic conductivity → more loss of brine (recharge to groundwater)
- More recharge to groundwater → higher mound
- Higher mound → more groundwater flow to marsh
- If groundwater is raised up to the pond → **groundwater salinity ≈ pond salinity**
- More groundwater flow @ higher salt concentration → **more salt flux to marsh**

Reminder: results to January 2021

1. Near the visitor centre indicate a +0.7 m increase in groundwater elevation from 2014 to November 2020.

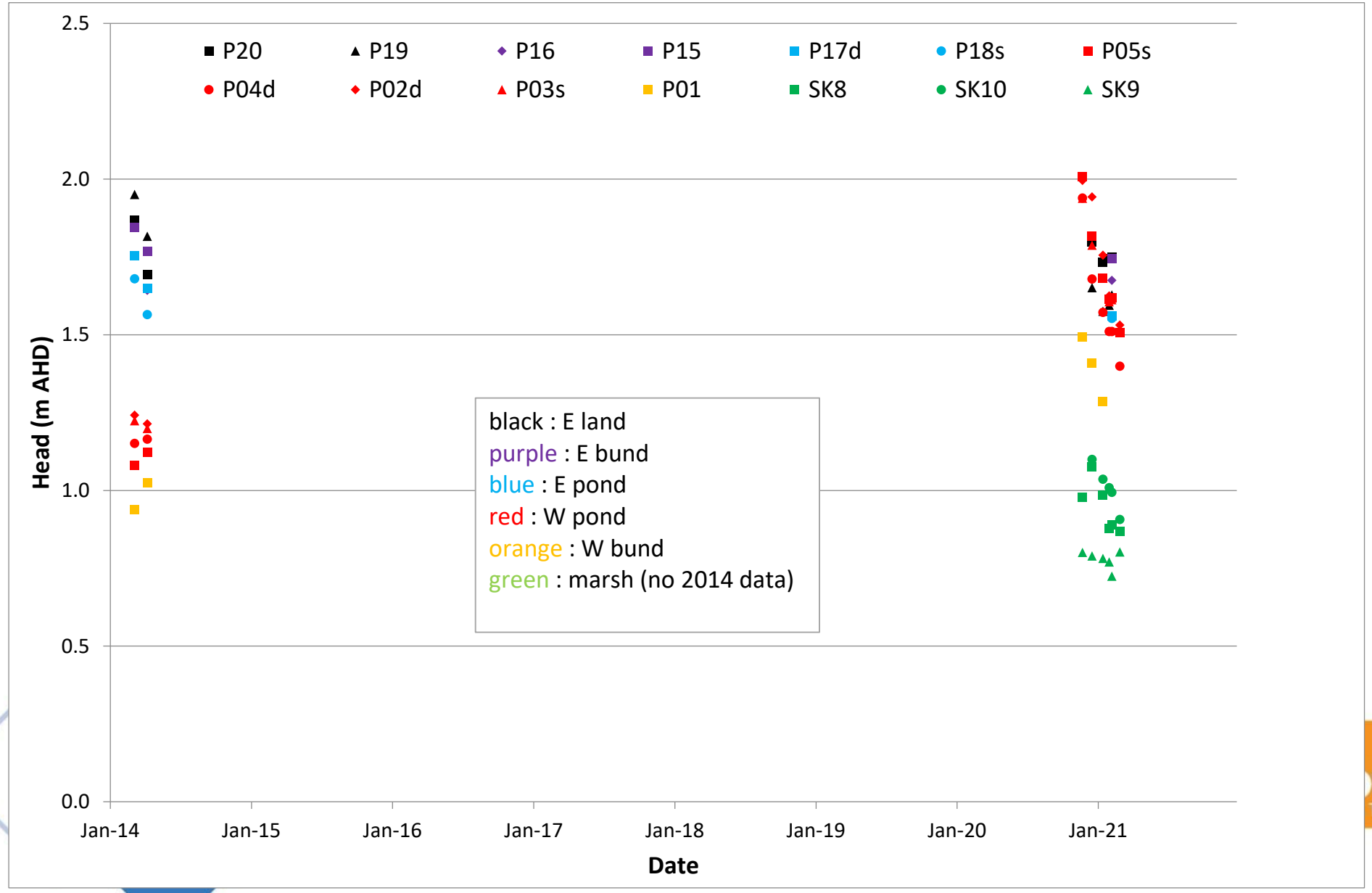
2. Groundwater **mounded right up to the pond and above the gypsum seal** in pond PA6 in November 2020.

Transect A


Dry Creek Salt Fields – Section 2
Piezometer Locations
N
St Kilda
15,16,17, 18, 19,20
1,2,3,4,5
A
21,22,23,24
6,7,8
B
Barker Inlet
12,13,14
C
9, 10,11

Transect A

Transect A – groundwater heads

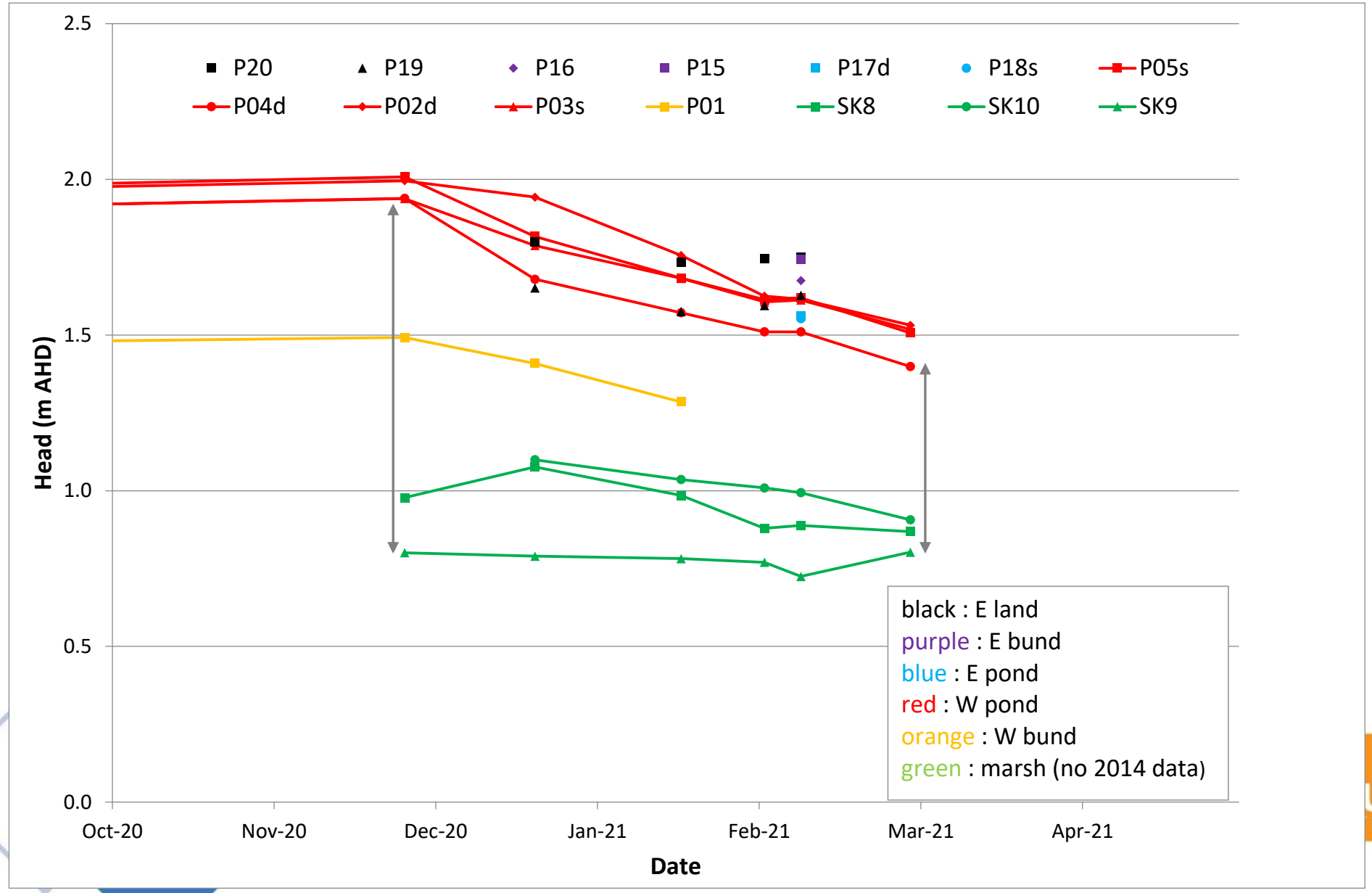


2014 : hydraulic gradient from E to W

2020/21 :

- higher heads in the W
- E heads similar to 2014
- E pond heads ~ W heads
- mounding > hydraulic gradient
- Green marsh heads ~ 2014 bund heads
- heads decline in time

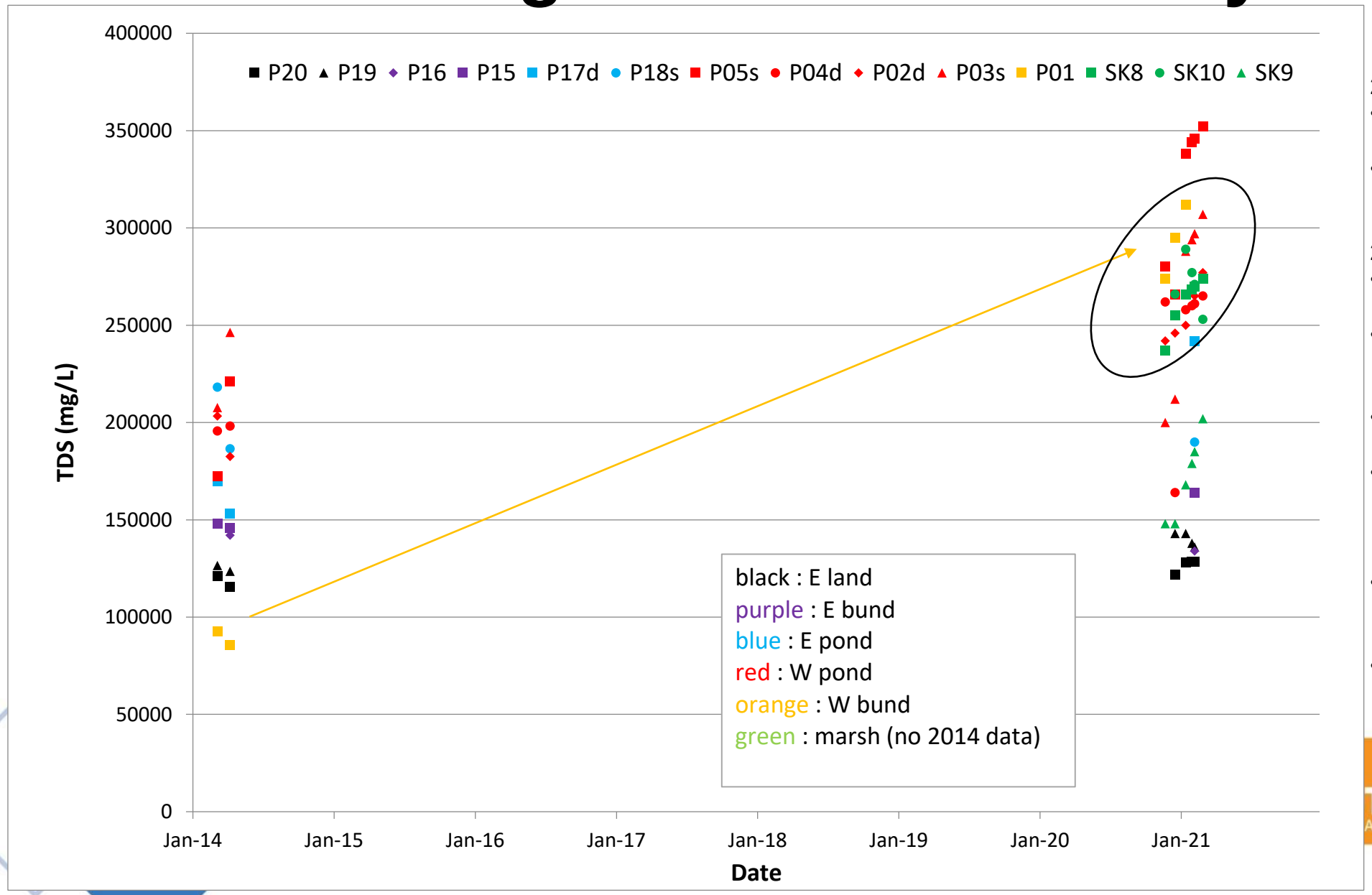
Transect A – trends in groundwater head



2020/21 :

- ~ 0.15 m/months decline in W pond wells (~ 0.5 m decline from late Nov. 2020 to early March 2021)
- much less change in marsh wells, especially SK9 (furthest from PA6)
- Late 2020 heads in the W pond > E pond (mounding > gradient)
- Hydraulic gradient has declined since November 2020 by ~ 40%

Transect A – groundwater salinity



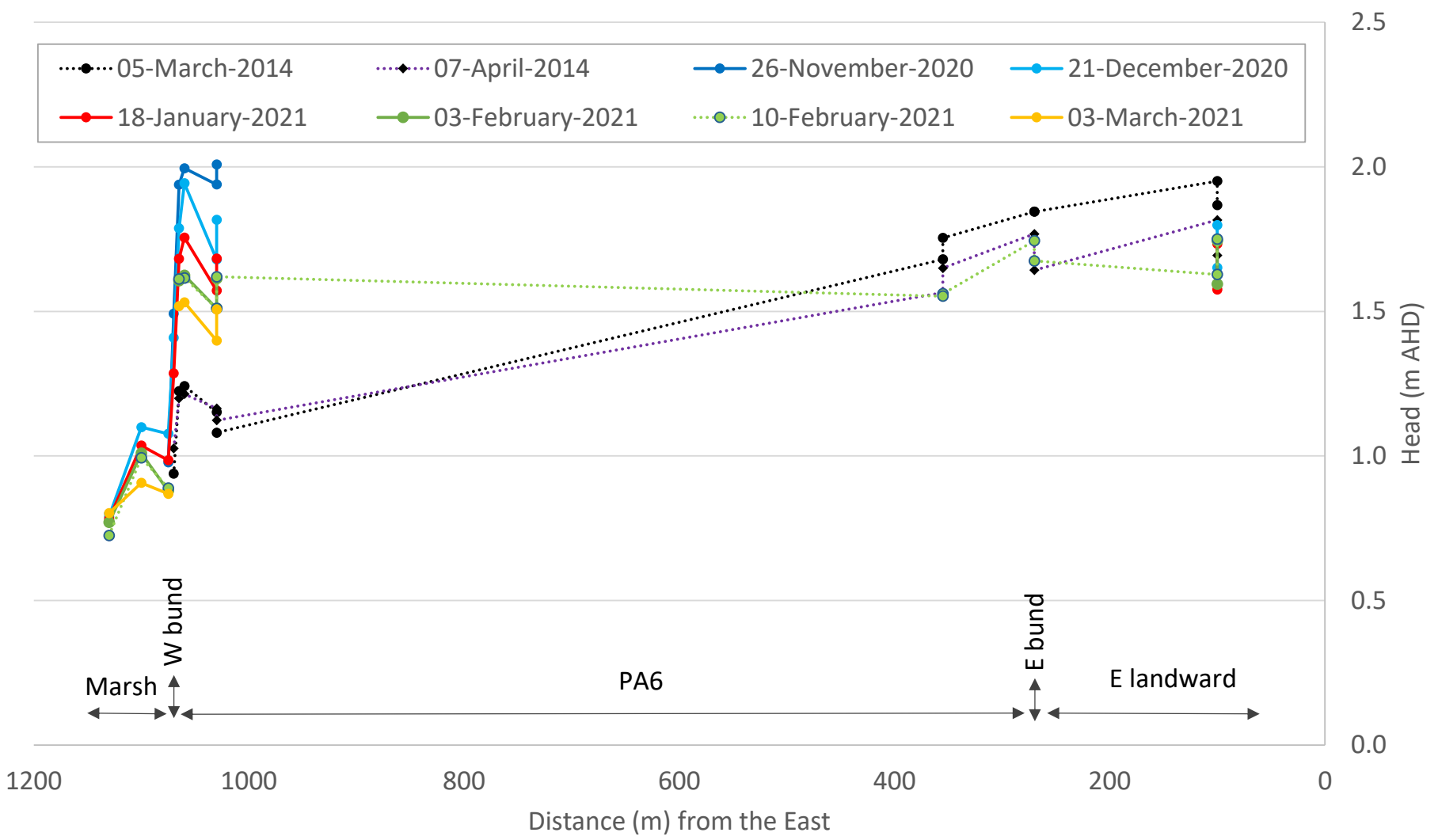
2014:

- largest TDS in pond wells (E and W)
- smaller TDS east of PA6 and bund wells

2020/21:

- TDS in the west increased
- TDS in the east about the same as in 2014
- TDS in W bund well P01 tripled
- TDS in SK8 and SK10 marsh wells approx. the same range as W pond wells
- TDS in SK9 (furthest W from PA6) is lowest but 3-4 times that of seawater
- Lack of dilution in the west in 2020/21 with respect to 2014

Transect A – groundwater head



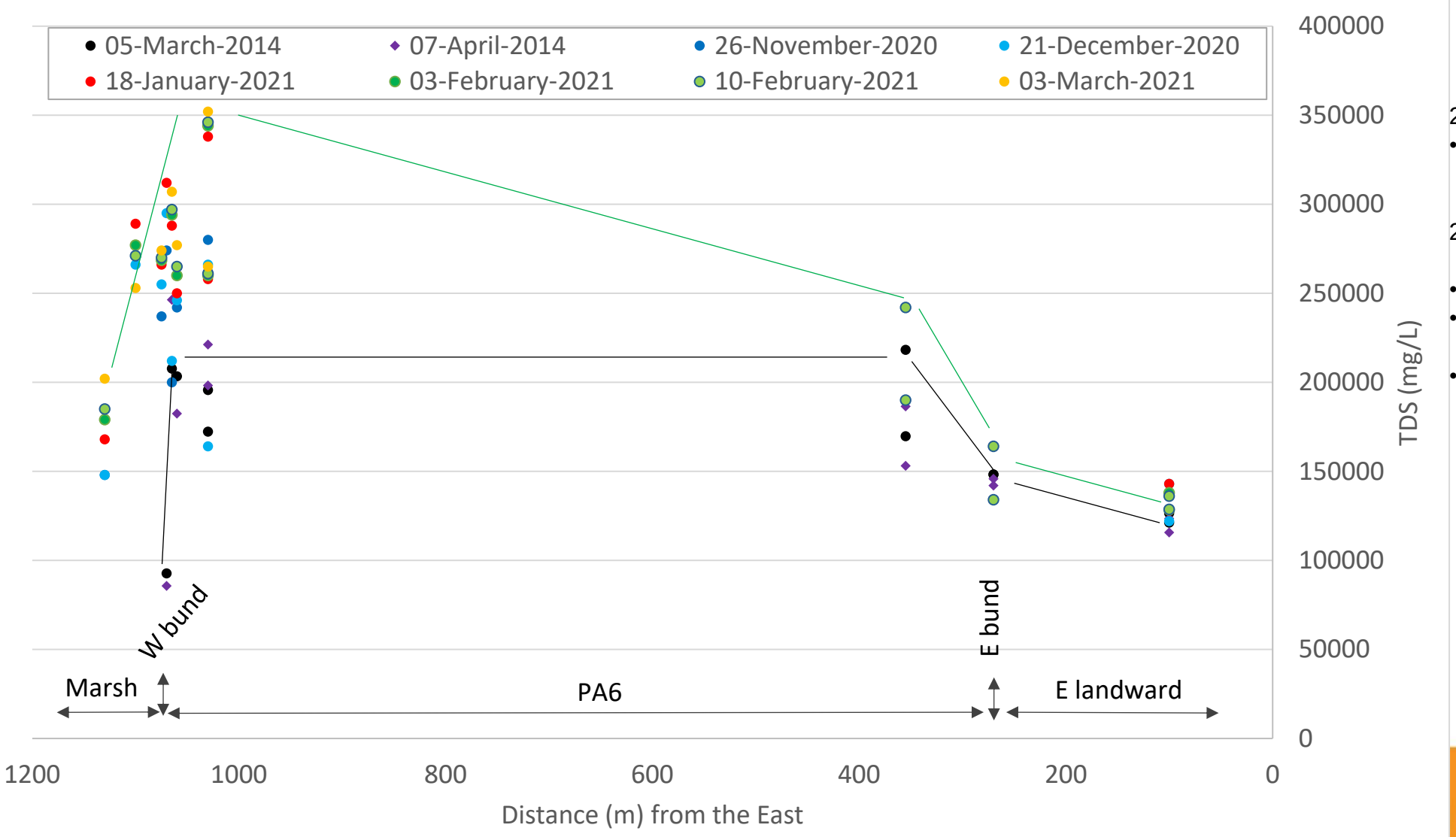
2014:

- Gradient from E to W

2020/21:

- Late 2020 head in W increased > heads in the east
- mounding > hydraulic gradient
- heads are declining in time

Transect A – groundwater salinity



2014:

- Salinity is high beneath PA6 and decreases to both east and west

2020/21:

- Salinity increased everywhere
- in the West
- Large increase in the western bund well

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Conclusions to March 2021, Transect A

1. Groundwater heads beneath western PA6 have declined about 0.5 m since late November 2020.

2. Western bund well P01 salinity tripled since 2014.

3. Marsh well salinities in 2020/21 are high.

4. Dilution effect that was transparent in 2014 is not present in 2020/21 to March 2021.

5. The hydraulic gradient driving groundwater towards the marsh has decreased by about 40% since November 2020.

6. The salt flux towards the marsh has decreased by about 35% since November 2020.

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