Preliminary Analysis of Deep Injection Wells – Draft For Discussion Purposes Only

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The Corps of Engineers took deep injection wells (DIWs) out of the CERP Lake Okeechobee Watershed Restoration Project in 2017. As far as I know there are no remaining deep injection wells in CERP that are supported by the Corps. This makes sense because a fundamental principle of CERP is to keep the water in the Everglades system, and to stop the wasteful discharge of water – obviously ***DIW violates this fundamental principle***. In addition, with close to 1,000 new residents moving to Florida every year, along with over 100 million annual visitors, Florida cannot afford to permanently waste water – a valuable and limited resource.

The following conceptual-level analysis was conducted to better understand certain hydrologic and economic impacts associated with Deep Injection Wells (DIWs, also known as Underground Injection Wells, UICs). No analyses were conducted regarding the significant geologic, hydrologic uncertainties associated with underground injection technology. This analysis was performed for discussion purposes only and does not reflect any engineering design.

Assumptions:

- Capital cost of $8 million per 15 MGD well (SFWMD 2018)
- Annual operation and maintenance (O&M) costs of $185,000 per well (SFWMD 2017)
- Two sets of scenarios were evaluated:
    - 50 wells, with 17 for Lake discharges to the St. Lucie River and Estuary (SLRE) and 33 for the Caloosahatchee River and Estuary (CRE).
    - 100 wells, with 34 for Lake discharges to the St. Lucie River and Estuary (SLRE) and 66 for the Caloosahatchee River and Estuary (CRE).
- The wells were assumed to be located at unspecified locations along the St. Lucie Canal and the Caloosahatchee Canal, and only "operated" as an alternative discharge point in place of making damaging flood control discharges to the northern estuaries (i.e., no impact to available water for restoration, or water supply. Only reduction is to flow already lost to tide). No analysis of optimal sites for the wells was conducted. The location of the wells may positively, or adversely, influence the hydrologic efficiency of the wells, as well as capital and O&M costs.

To estimate potential impacts on Lake discharges to the estuaries, historical daily flow records from the SFWMD's DBHYDRO database were used. Daily lake flows to the estuaries were decreased up to the maximum capacity of the DIWs, and the cumulative percent reduction over the 1980-2018 period of record was tabulated. In addition, the estimated total capital and O&M costs were estimated, as was the unit cost ($ per acre foot). Variations in these assumptions will affect the results. In an (imperfect) attempt to reflect uncertainty, a sensitivity analysis was performed. The key uncertainties in developing flow and cost estimates were

- the mechanical efficiency of the wells (where 95% efficient = 5% downtime),
    - the sensitivity analysis used 90%, 95% and 100% efficiency
- the inflation rate (which ranged from 1.6%-2.9% in 2018)
    - the sensitivity analysis used 0%, 1.6%, 2.9% and 3.5% inflation rate
- equipment replacement time
    - the sensitivity analysis used 25 years and 50 years, and assumed an average cost over the replacement period equal to the capital cost divided by the replacement period.

Results. The tables below reflect how the reduction in flows to the estuaries and cost estimates vary with these factors. For example, assuming 95% efficiency, 1.6% inflation rate and a 25-yr life of the capital works:

- For the 50-well case
    - The conceptual cost is estimated at approximately $1.35 billion over 39 years
    - The wells may reduce flows to the estuaries by about 27 percent
    - The 1980-2018 historical peak Lake flow to the St. Lucie Estuary was 7,740 cfs; 17 wells would reduce the peak by 395 cfs (783 AF/day) for a reduction of only 5%.
    - The peak Lake flow to the Caloosahatchee Estuary was 8,967 cfs; 33 wells would reduce the peak by 766 cfs (1,519 AF/day) for a reduction of only 8%.
    - The cumulative time the wells would sit idle is estimated at 74%.

- For the 100-well case
    - The conceptual cost is estimated at approximately $2.71 billion over 39 years
    - The wells may reduce flows to the estuaries by about 45 percent
    - The 1980-2018 historical peak daily Lake flow to the St. Lucie Estuary was 7,740 cfs; 34 wells would reduce the peak by 789 cfs (1,565 AF/day) for a reduction of only 10%.
    - The peak Lake daily flow to the Caloosahatchee Estuary was 8,967 cfs; 66 wells would reduce the peak by 1,532 cfs (3,038 AF/day) for a reduction of only 16%.
    - The cumulative time the wells would sit idle is estimated at 79%.

Table 1. Results From the 50-well Analysis

1980-2018 **Calendar Years** ***DRAFT - For Discusson Purposes Only***

Scenario	# of SLRE Wells	# of CRE Wells	Efficiency of Wells	Inflation Rate	Equipment Replacement time, yr	Reduction in Flow to Estuaries	Estimated Cost	Cost/AF/yr	Comment
1	17	33	100%	0.0%	50	28%	$672,750,000	$80	Does not factor in inflation, pump down-time
2	17	33	100%	1.6%	50	28%	$924,150,008	$110	Does not factor in pump down-time
3	17	33	100%	2.9%	50	28%	$1,218,977,925	$145	Does not factor in pump down-time
4	17	33	100%	3.5%	50	28%	$1,392,504,629	$165	Does not factor in pump down-time
5	17	33	95%	0.0%	25	27%	$984,750,000	$122	Does not factor in inflation
6	17	33	95%	1.6%	25	27%	$1,352,741,317	$167	Average inflation as of January 2019
7	17	33	95%	2.9%	25	27%	$1,784,301,021	$220	Highest inflation observed in 2018
8	17	33	95%	3.5%	25	27%	$2,038,303,877	$252	Assumed upper inflation
9	17	33	90%	0.0%	25	26%	$984,750,000	$127	Does not factor in inflation
10	17	33	90%	1.6%	25	26%	$1,352,741,317	$174	Average inflation as of January 2019
11	17	33	90%	2.9%	25	26%	$1,784,301,021	$230	Highest inflation observed in 2018
12	17	33	90%	3.5%	25	26%	$2,038,303,877	$262	Assumed upper inflation

Table 2. Results From the 100-well Analysis

1980-2018 **Calendar Years** ***DRAFT - For Discusson Purposes Only***

Scenario	# of SLRE Wells	# of CRE Wells	Efficiency of Wells	Inflation Rate	Equipment Replacement time, yr	Reduction in Flow to Estuaries	Estimated Cost	Cost/AF/yr	Comment
1	34	66	100%	0.0%	50	46%	$1,521,500,000	$110	Does not factor in inflation, replacement cost, pump down-time
2	34	66	100%	1.6%	50	46%	$2,090,069,473	$151	Does not factor in replacement cost, pump down-time
3	34	66	100%	2.9%	50	46%	$2,756,856,059	$199	Does not factor in replacement cost, pump down-time
4	34	66	100%	3.5%	50	46%	$3,149,306,270	$227	Does not factor in replacement cost, pump down-time
5	34	66	95%	0.0%	25	45%	$1,969,500,000	$147	Does not factor in inflation
6	34	66	95%	1.6%	25	45%	$2,705,482,634	$202	Average inflation as of January 2019
7	34	66	95%	2.9%	25	45%	$3,568,602,042	$267	Highest inflation observed in 2018
8	34	66	95%	3.5%	25	45%	$4,076,607,755	$304	Assumed upper inflation
9	34	66	90%	0.0%	25	43%	$1,969,500,000	$153	Does not factor in inflation
10	34	66	90%	1.6%	25	43%	$2,705,482,634	$210	Average inflation as of January 2019
11	34	66	90%	2.9%	25	43%	$3,568,602,042	$277	Highest inflation observed in 2018
12	34	66	90%	3.5%	25	43%	$4,076,607,755	$319	Assumed upper inflation