Appendix D

Water Quality Assessment

Objective

The Floridan aquifer system (FAS) is the primary source of potable water in northeast Florida. These groundwater withdrawals have resulted in lowering of water levels of the FAS within the region. Lower water levels in the aquifer create a potential for decreased water quality in the form of saltwater intrusion. Saltwater intrusion can occur from saltwater moving inland from the ocean (i.e., lateral intrusion) or from relic seawater migrating vertically (i.e., upconing). Saltwater intrusion can affect the productivity of existing infrastructure, resulting in an increase in treatment costs and infrastructure costs. Although saltwater intrusion poses a challenge for all affected water users, the issue is particularly acute for small public supply systems and self-supply water users that may have fewer options for infrastructure modifications.

An evaluation was conducted to assess the potential degradation of groundwater quality in the UFA from saltwater intrusion that may constrain the availability of groundwater sources. This was accomplished through creation and review of a combination of chloride concentration mapping efforts and statistical analyses of time-series chloride data. Chloride is a useful chemical indicator of saltwater intrusion because it is one of the principal chemical constituents in seawater and is unaffected by ion exchange (unlike sodium, the other principal component). The Florida Safe Drinking Water Act (sections 403.850 - 403.864, F.S.) directs DEP to develop rules that reflect national drinking water standards. Chapters 62-550, 62-555, and 62-560, Florida Administrative Code (F.A.C.), were promulgated to implement the requirements of the Florida Safe Drinking Water Act. More specifically, chapter 62-550, F.A.C., lists secondary drinking water standards (SDWS) for finished drinking water that include concentration limits for Total Dissolved Solids (TDS) (500 milligram per Liter (mg/L) and chloride (250 mg/L). Increasing trends in chloride concentration can be an indicator of saltwater intrusion. Maps created to evaluate the status and trends in chloride concentrations are listed below:

- Recent Chloride Concentration Map of the Upper Floridan Aquifer
- Movement of the Saltwater Interface in the Upper Floridan Aquifer
- 2021 Annual Assessment of District Monitoring Network – Status and Trends
- Production Well Water Quality Assessment – Status and Trends

The methodologies used to create these maps are included in Attachment A and provide an overview of dataset selection and preparation (5-year average vs annual concentrations and 5-year intervals for movement of the isochlor); dataset source (SJRWMD and SRWMD District Monitoring Well networks gap-filled with SJRWMD CUP production wells); dataset screening for similar construction and dataset consistency for the comparison maps. Details on mapping techniques are also provided.

Results and Observations

Recent Chloride Concentration Map of the Upper Floridan Aquifer

A generalized map of 2016-2020 average chloride concentrations in the upper portions of the UFA was developed using all available SJRWMD and SRWMD (Districts) monitoring and SJRWMD CUP production well water quality data. As can be seen in Figure D1, the majority of the planning area has less than 100 mg/L of chloride in the groundwater. In the eastern portion of the planning area there are two areas of elevated chloride concentrations in coastal Nassau and central Duval counties. There is also an overall increase in concentration from north to south, where you find broad areas of much higher chloride concentrations in southern St. Johns, eastern Putnam, and Flagler counties. Given the elevated concentrations, these regions are identified as the areas of water quality concern.

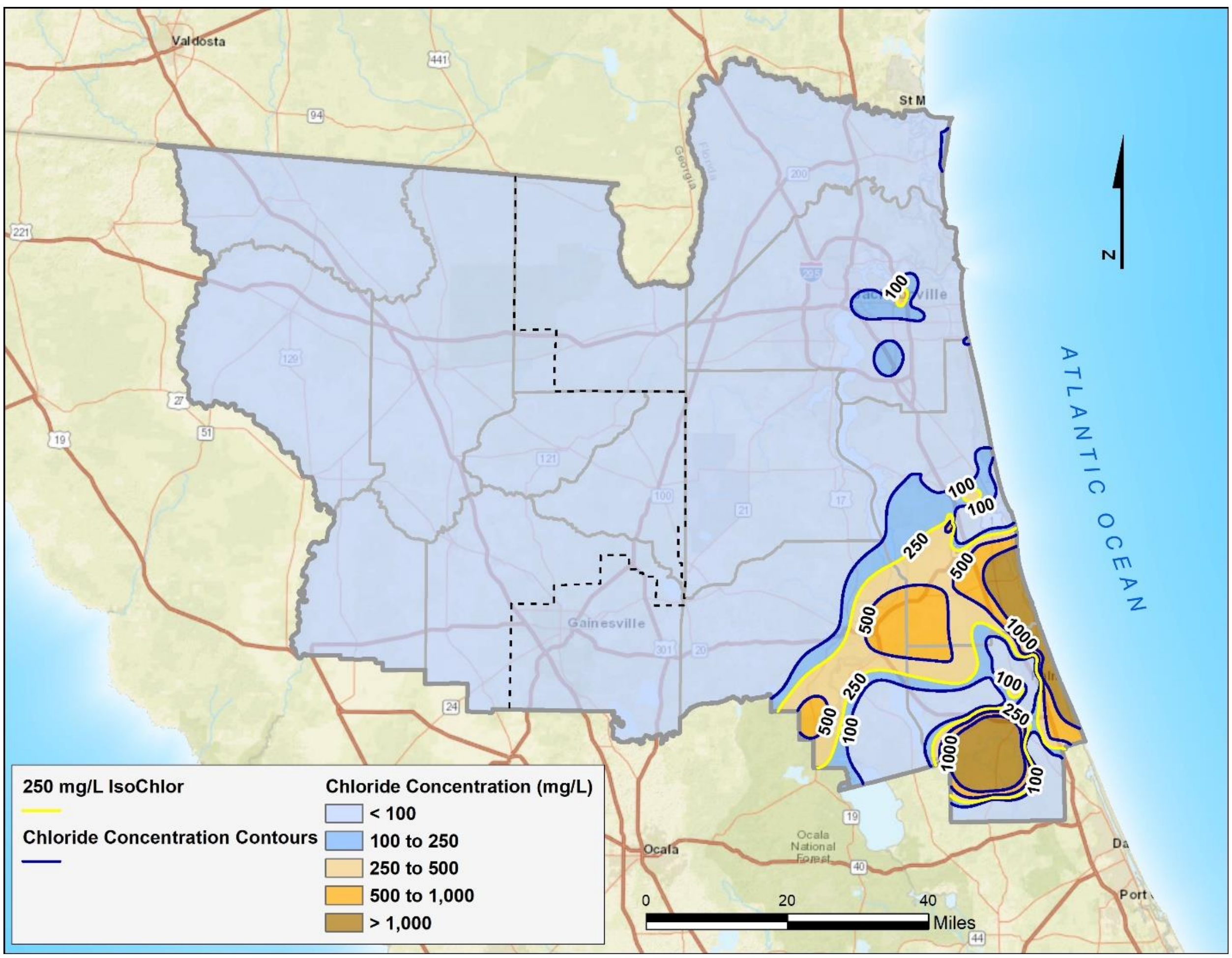

Figure D1. 2016-2020 Average chloride concentrations in the Upper Floridan Aquifer

Trends in Chloride Concentrations

In addition to the recent chloride concentration map of the region, which provides a regional representation of the current status of chloride concentrations in the UFA, trends in water quality data were also evaluated. Water quality trends indicate whether chloride concentrations are increasing or decreasing over time.

Movement of the Saltwater Interface in the Upper Floridan Aquifer

The trends were first evaluated using a series of chloride concentration maps of the UFA at five-year intervals from 2006 to 2020. These maps were combined into a single map showing the approximate location of the 250 mg/L isochlor, a line of equal concentration, for the following time-intervals: 2006-2010AVG; 2011-2015AVG; and 2016-2020AVG. The 250 mg/L isochlor is only present in the eastern portions of the NFRWSP area. Inferences were made on the movement of the saltwater interface by comparing the relative location of the 250 mg/L isochlor through time (Figure D2).

In Duval County, the earliest isochlor (2006-2010AVG) is not present. The isochlors then expand from the 2011-2015AVG time-interval to the 2016-2020AVG time interval. Expanding isochlors isolated from the coast are indicative of upconing or the upward vertical movement of deeper lower quality water, as opposed to lateral saltwater encroachment from the coast. This kind of vertical movement can occur due to natural upward gradients in flow within the aquifer system but can also be the result of pumping.

In southern St Johns, eastern Putnam, and Flagler counties the three different isochlor lines from 2006 to 2020 are not distinct from each other. This is an indication that the isochlor has not moved much since 2006. It should be noted that there is no consistent movement of the isochlor in a landward direction near the coast which would have been indicative of lateral saltwater encroachment. This region has been stable for the past 15 years; however, it is susceptible to upconing and lateral saltwater encroachment due to low water levels in the aquifer.

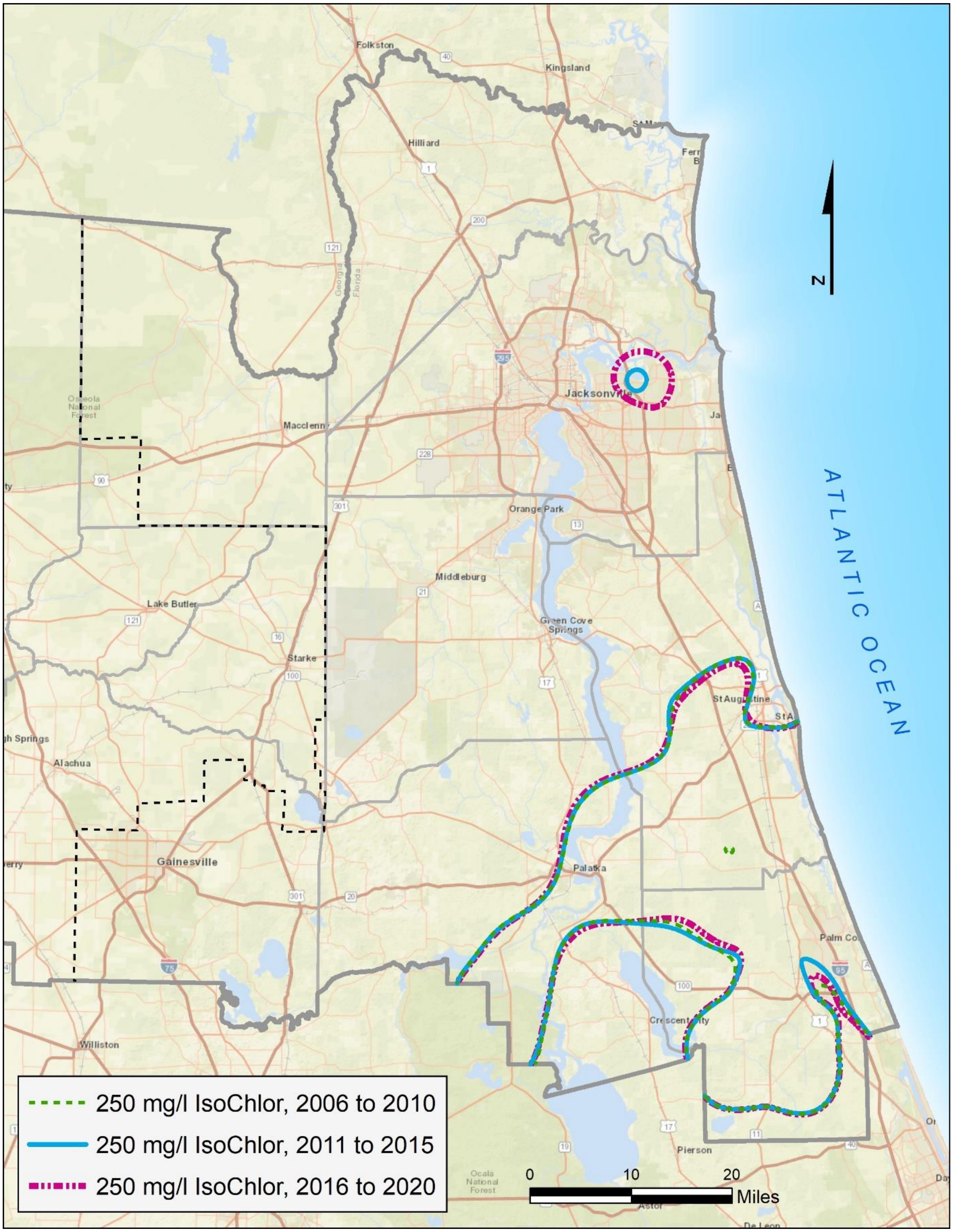

Figure D2. Movement of the saltwater interface in the Upper Floridan aquifer

2021 Annual Assessment of Districts' Monitoring Networks – Status and Trends

The second way status and trends in water quality were evaluated was to consider the Districts' 2021 annual assessment of groundwater quality from the regional monitoring well networks. The status and trends map shows the chloride concentration status in the UFA at the monitoring well that location (Figure D3). The status assessment period was five years, January 1, 2017, to December 31, 2021. The trend assessment period was 15 years, from January 1, 2007, to December 31, 2021.

The majority of the wells in the region had no detectable change in chloride concentrations from 2007 to 2021 and are considered stable. Some areas of low chloride concentration (less than 50 mg/L) located in the western portion of the planning area, northern Duval, southern Duval and northern St. Johns and southern Putnam counties have wells with increasing trends of less than 5%. Given the low status (concentrations of less than 100 mg/L, with most of the wells below 50 mg/L) and low rate of change, these areas are not approaching the potable limit for chloride concentration in the UFA. However, two wells were identified with a high rate of change (greater than 5%). One well is located in southern Putnam with a low chloride concentration. The other well has a high concentration (greater than 250 mg/L) and is located in eastern Flagler County. This area has already been identified as one of the areas of water quality concern but as a region has been stable in regard to movement of the saltwater interface for the past 15 years.

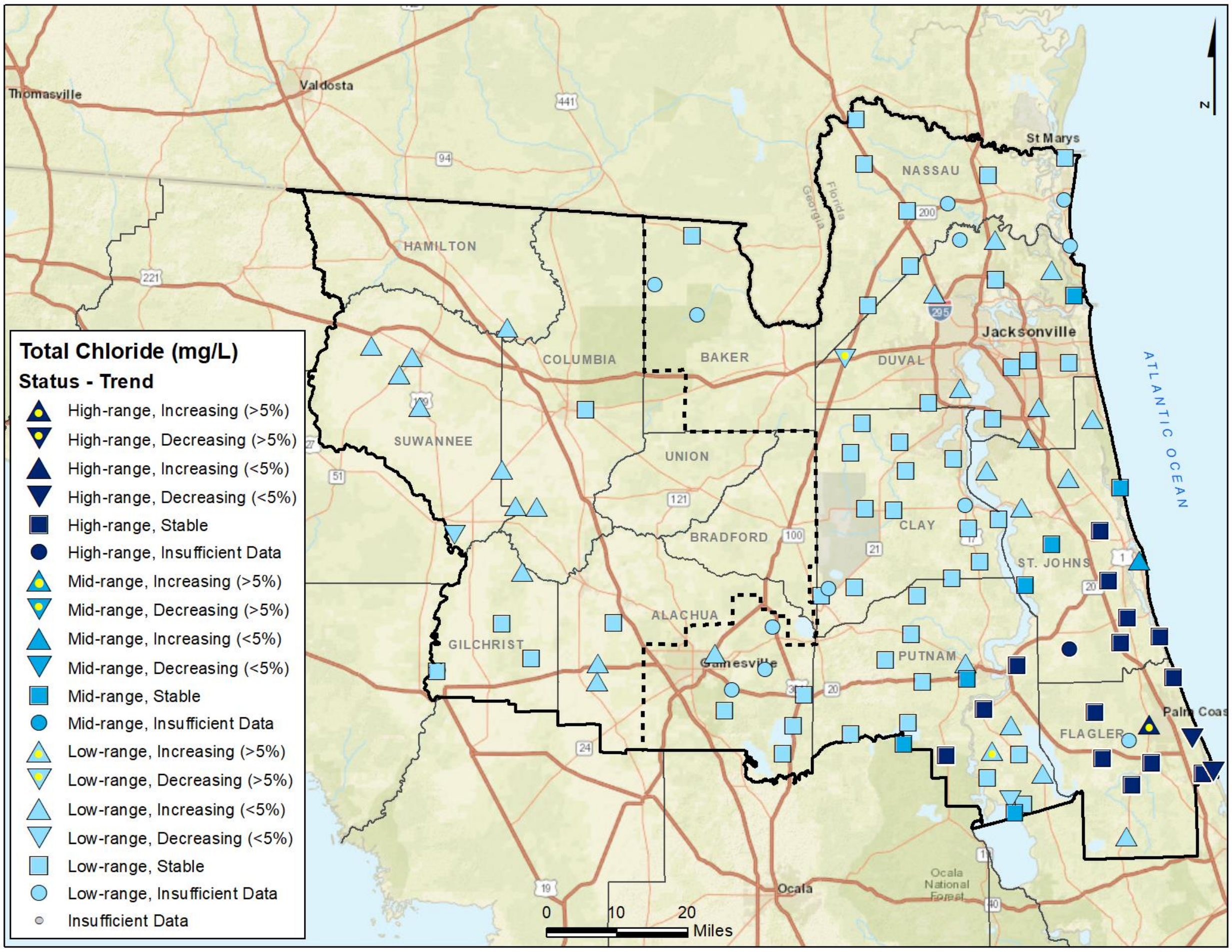

Figure D3. 2021 Annual assessment of Districts' monitoring networks – Status and Trends (High – greater than 250 mg/L; Mid – 50 to 250 mg/L; and Low – less than 50 mg/L)

Production Well Water Quality Assessment

The final evaluation of status and trends in water quality was conducted on 17 permitted production wells in the SJRWMD region. These wells were evaluated in the 2017 North Florida Regional Water Supply Plan (NFRWSP) and were selected for further evaluation since they had shown statistically significant increasing trends in chloride concentrations. Since statistically significant trends in chloride concentration can be an indicator of groundwater degradation due to saltwater intrusion, the focus of this evaluation was on chloride time series data.

Water quality from these wells was assessed over a period of record from 1998 to 2021, based on the availability of data. Time-series graphs of chloride concentrations and the average rate of withdrawal were visually interpreted for breaks in slope, then each segment was statistically analyzed for significant trends. The assessment showed that chloride concentrations increased, decreased, or stayed stable at different intervals over the period of record for a given well. The final segment was used to evaluate the current potential trend in concentration. Of the 17 wells assessed, five wells showed an increasing trend, one well had a decreasing trend and 11 wells were stable or showed no trend at all. (Figure D4).

Out of the five wells with increasing trends, four are located in central Duval County and one is located in southern Flagler County. The Floridan aquifer in Duval County is characterized by faulting and fracturing that allows lower quality water from the LFA to mix with fresh water in the UFA through upward leakage (Leve 1983). This upconing appears to be localized to wellfields as other monitor wells in the vicinity do not show increasing trends. In Flagler County, the aquifer has a higher transmissivity (Durden et al. 2019), which allows seawater to encroach from the coast more easily when freshwater levels decline, making wells here more susceptible to saltwater intrusion. As discussed earlier, the area has been stable with regard to lateral saltwater encroachment for the previous 15 years.

Groundwater quality degradation in the areas identified may constrain the availability of fresh groundwater due to the susceptibility to both vertical and lateral saltwater intrusion, but with continued wellfield management these trends can be addressed. Wellfield management, such as back plugging, reduced pumping rates, and relocation of withdrawals to less susceptible areas has been successful in managing the increasing chloride trends in the majority of these wells.

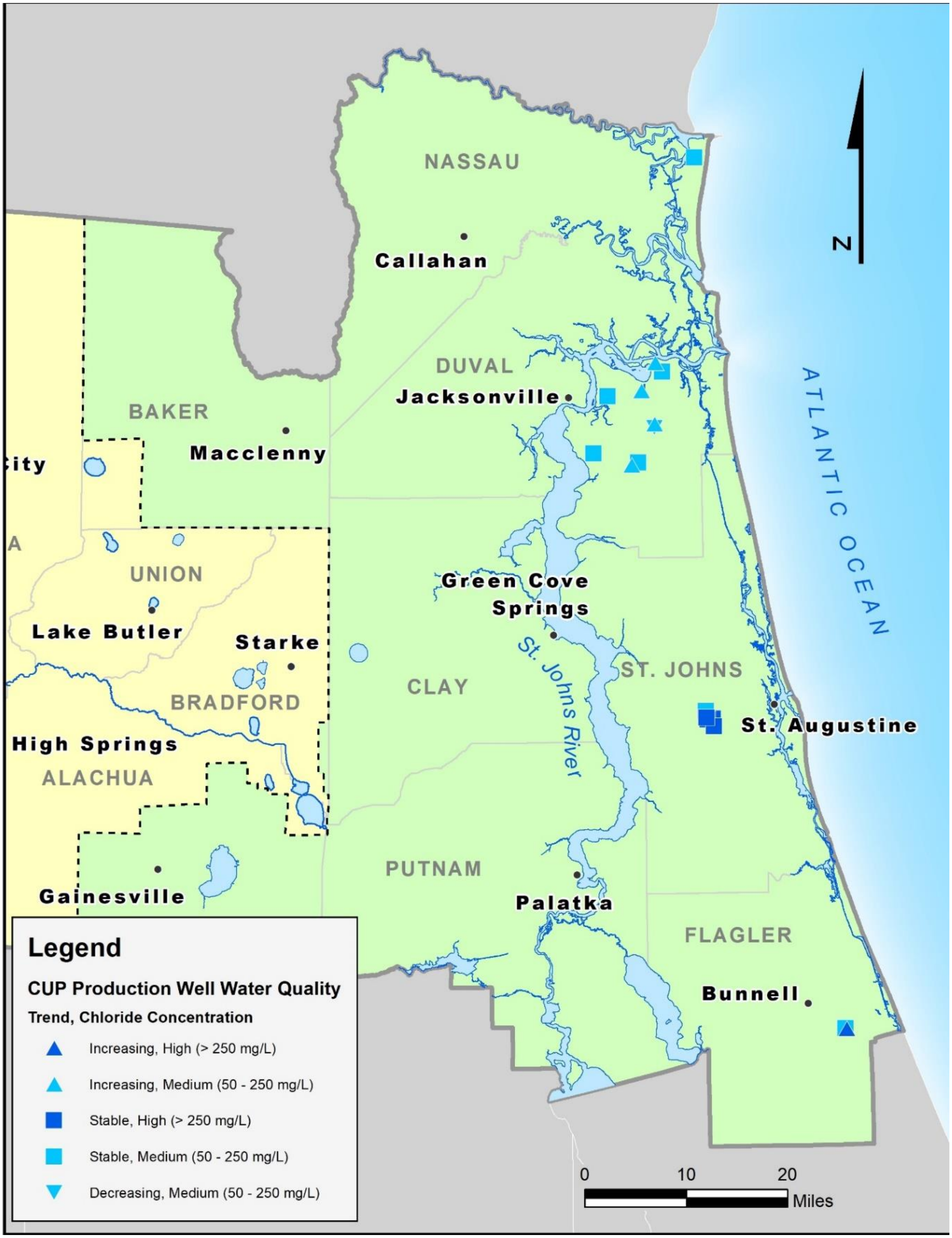

Figure D4. Production well water quality assessment – Status and Trends

Hydrogeology and other possible contributing factors

Numerous investigations of water quality in the Floridan aquifer system (FAS) have been made by the SJRWMD since the mid-1970s. Prior to this, the U.S. Geological Survey investigated water quality in the FAS. These investigations have continued as more demand has been placed on the FAS to provide potable water for a growing population in North Florida.

Early studies of North Florida water quality by SJRWMD staff noted that the Hawthorne Formation generally thickens to the north and west and is thin or absent in southern Flagler County (Frazee and McClaugherty 1979). In coastal Nassau and Duval counties, this confining unit provides a barrier retarding the downward migration of saline water in the shallow aquifers toward the UFA. Additional studies conducted in Nassau, southern Duval, and northern St. Johns and Clay counties identified areas of buried faults in these counties that may allow for lower quality water to migrate upward due to natural hydraulic gradient or induced by pumping (Leve 1983; Spechler 1994). A more recent study in Duval County further confirmed that the pathways of upward saline water movement are along interconnecting vertical and horizontal fractures or solution zones (Phelps 2001).

In Flagler and southern St Johns counties where the confining unit is thin or missing, deeper connate water (water trapped in pores during formation of the rock) in the FAS migrates upward due to natural discharge in the Haw Creek basin and where historically overly deep wells coupled with large agricultural withdrawals induced further connate upwelling or intrusion (Leve 1983; Navoy and Bradner 1987). Phelps (2001) also noted the upward migration of lower quality water in St. Johns, Putnam, and Flagler counties and near the City of Fernandina Beach occurs through natural leakage or discharge through springs or pumping wells. Indications of upconing and lateral saltwater intrusion in coastal Flagler County, noted by Frazee and McClaugherty (1979) and Navoy and Bradner (1987), can also be seen in Figure D1.

Figure D5 shows drawdown in the UFA as it relates to the faults identified by Leve (1983) and areas of high chloride concentration in central Duval County. Pumping in this region may be causing additional preferential movement of lower quality water along the faults and fractures in the FAS. Figure D6 shows the relationship of discharge areas in the UFA as well as a high transmissivity zones in southern St. Johns, eastern Putnam, and northern Flagler counties as it relates to areas of high chloride concentrations (Durden et al. 2019, Figure 4-74). Pumping in this region would promote additional upward movement of lower quality water in the FAS.

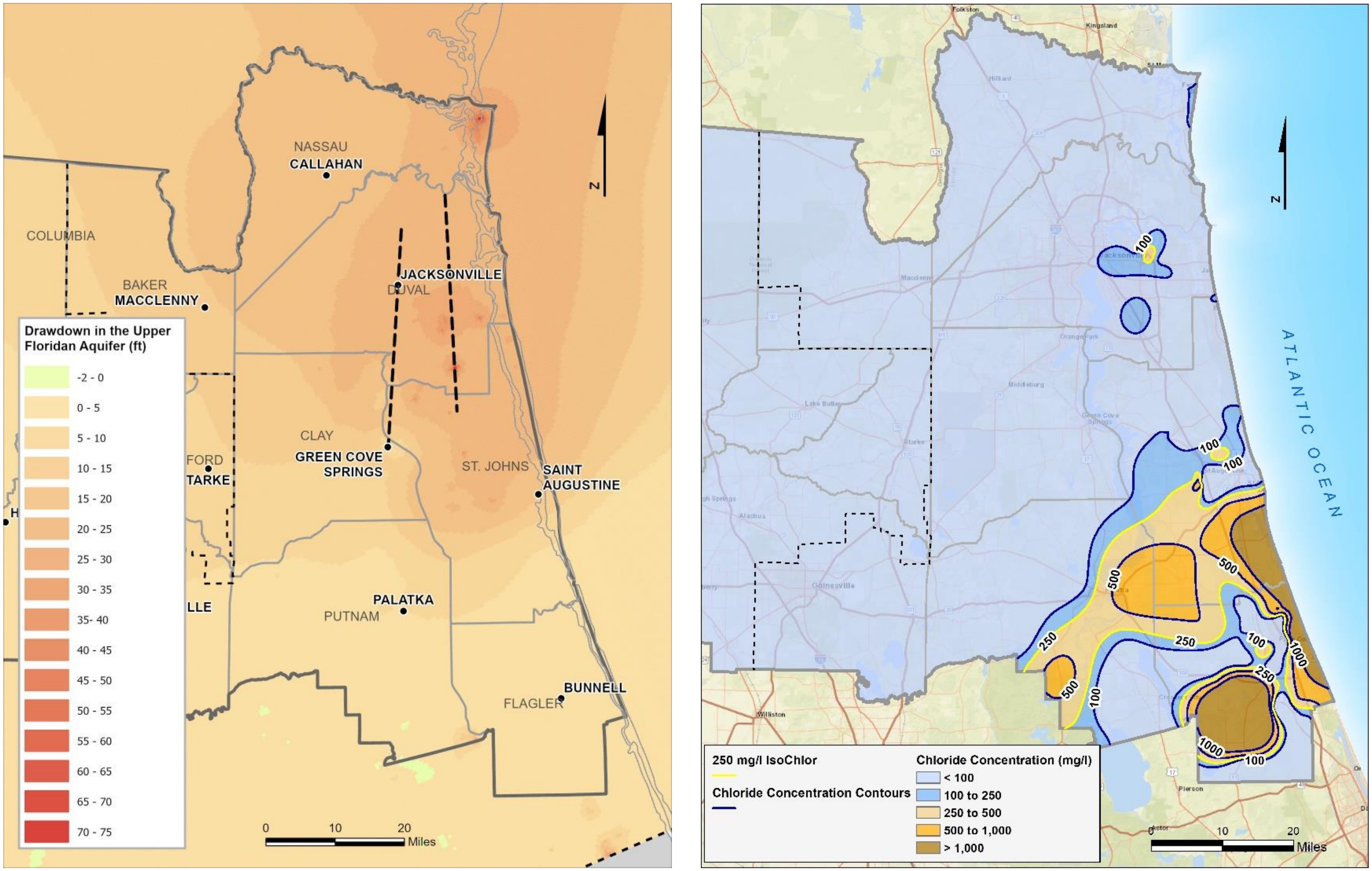

Figure D5. Possible Contributing Factors to Elevated Chloride Concentrations in UFA – Left Figure - UFA Drawdown (Pumps Off to Current Pumping), FAS Fracturing (Leve 1983) and Right Figure - Recent (2016-2020AVG) Chloride Concentrations in the UFA

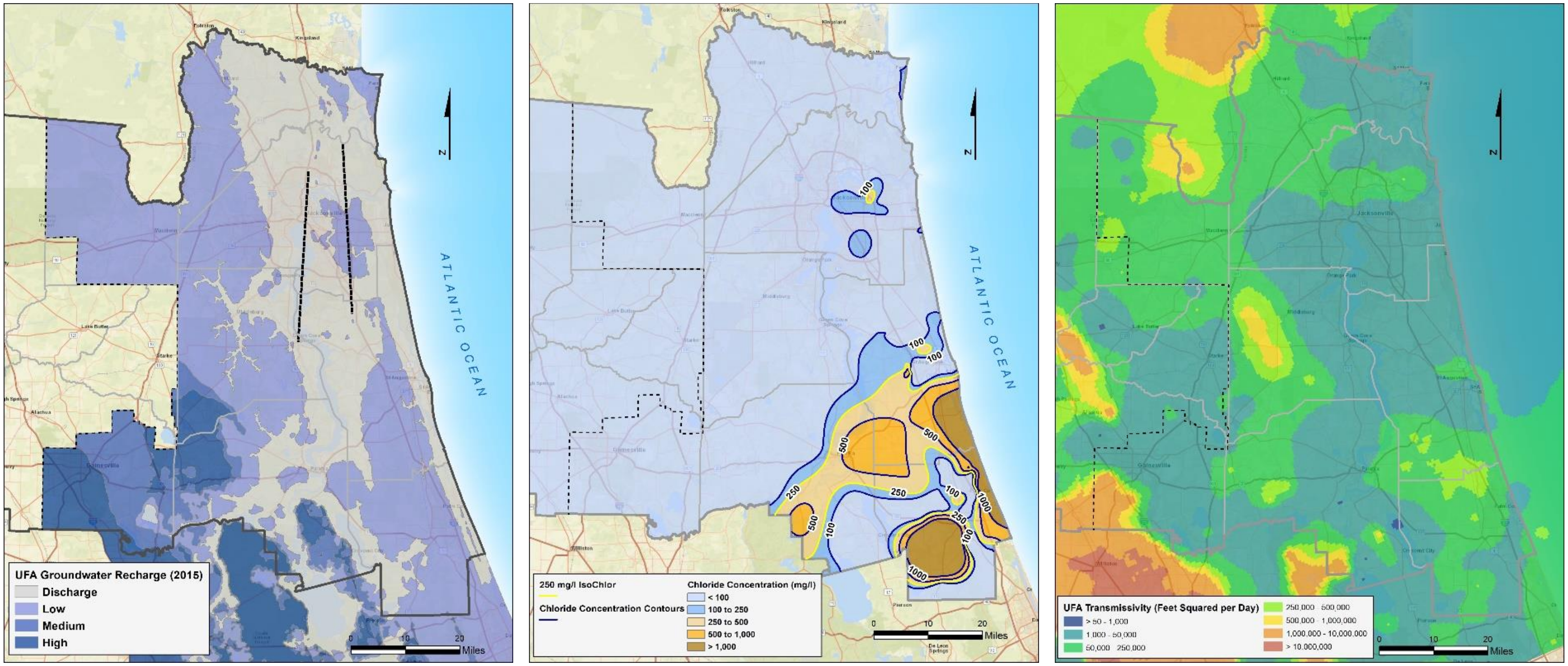

Figure D6. Possible Contributing Factors to Elevated Chloride Concentrations in UFA – Left Figure - UFA Groundwater Recharge/Discharge Areas (2015), Middle Figure - Recent (2016-2020AVG) Chloride Concentrations in the UFA and Right Figure - Transmissivity in the UFA (Durden et al. 2019)

Constraints and Recommendations

The results of the water quality assessment showed that the majority of the NFRWSP area west of the St. Johns River has less than 100 mg/L of chloride and the majority of wells in the Districts' monitoring well networks show no detectable change in chloride concentrations from 2006 to 2020. Areas of elevated chloride concentration were identified in the following counties: coastal northeast Nassau, central Duval, southern St. Johns, eastern Putnam, and portions of Flagler counties. These areas of high chloride concentrations in the UFA are in areas of faulting and fracturing (Nassau and Duval counties) and areas of naturally occurring upward leakage of salty water through thin semi-confining units (St. Johns, eastern Putnam, and portions of Flagler counties) (Spechler. 1994).

A spatial analysis of movement of the 250 mg/L isochlor identified an area of potential upconing in central Duval County where isochlor results expanded from the 2011-2015 average as compared to the 2016-2020 average. Several CUP production wells in this region also show increasing trends in chloride concentration which further suggests localized upconing. An assessment of the movement of the isochlor in southern St Johns, eastern Putnam and Flagler counties shows the isochlor has been stable since 2006, with no consistent movement in a landward direction near the coast. While the region is stable, one CUP production well in Flagler County showed an increasing trend in chloride concentrations.

When viewed in total, the primary conclusion of this analysis is that groundwater quality may constrain the availability of fresh groundwater in relatively limited geographic areas of the NFRWSP region east of the St. Johns River in portions of Duval, Nassau, St. Johns, Putnam and Flagler counties. Results of the water quality analysis show that saltwater intrusion in Duval and St. Johns counties appears to be localized due to upconing in response to withdrawals of groundwater from a single well and/or combined withdrawals from a wellfield. Flagler County shows indications of both localized upconing and possible lateral saltwater intrusion. Since the increasing chloride concentrations in Duval, St. Johns, and Flagler counties are at least partially related to upconing, these concerns are being managed through appropriate well construction, pumping operations and reverse osmosis for treatment of brackish UFA water. The effectiveness of wellfield management was evident in the reassessment of the 17 CUP production wells that had increasing trends in the previous NFRWSP from 2017. Due to back-plugging and withdrawal reductions, only five of the 17 wells continue to have an increasing trend.

It should be noted that some public supply utilities in Flagler and Duval counties have developed or are proposing to develop additional wellfields in less susceptible areas further inland. New wellfields are necessary to meet increased water demand of growing populations while reducing risk of water quality degradation in areas susceptible to upconing. The ability to shift UFA withdrawals to the west may be constrained by water bodies with adopted minimum flows and levels.

Recommendations

Saltwater intrusion can occur from seawater moving inland from the ocean through lateral or vertical movement or from relic saltwater migrating vertically near a pumping well (i.e., upconing). Saltwater intrusion can affect productivity of existing infrastructure, resulting in increased treatment and infrastructure costs. Degrading water quality can dictate back plugging, well inactivation and replacement, withdrawal point relocation, and conversion to alternative water supplies. Although saltwater intrusion poses a challenge for all affected water users, the issue is particularly acute for small public supply systems and self-supply water users that may have fewer options for infrastructure modifications.

Wellfield management plans and the further development of alternative water supplies such as reclaimed water, surface water, and brackish groundwater can reduce the potential for upconing and lateral intrusion. Additional alternative water supplies may be necessary in the future as utilities continue to shift withdrawals to the west to reduce water quality degradation. The SJRWMD Regulatory Program will continue to evaluate the potential for harmful upconing and lateral intrusion during CUP application review to ensure all permitting criteria are met prior to permit issuance. In addition, SJRWMD will investigate instances of unforeseen harmful water quality impacts potentially resulting from consumptive uses of water, and if verified, will require mitigation by the responsible permittee(s). Additionally, a density-dependent water quality model will be developed for this region to assess saltwater intrusion due to sea level rise (SLR) and other climate change impacts such as rainfall and evapotranspiration.

Attachment A

Methodology

Recent Chloride Concentration and Movement of the Saltwater Interface

Dataset Selection Overview

UFA groundwater quality data was evaluated to determine both the current status of chloride concentration and the movement of the freshwater/saltwater interface (SWI) through time. Two maps of the UFA were created - a recent chloride concentration map and a map showing the movement of the 250 mg/L isochlor. The five-year mean (or average (AVG) chloride concentration was used for these mapping exercises to capture average concentrations in the UFA rather than using concentration from a single year which may have reflected extreme climate conditions such as a drought or wet conditions.

The recent chloride concentration map is a regional representation of the 2016-2020AVG chloride concentration in the UFA. The movement of the 250 mg/L isochlor map was created by comparing a series of chloride concentration maps at five-year intervals from 2006 to 2020. Due to the relatively slow movement of groundwater, a 5-year interval was deemed sufficient to evaluate the movement of the SWI over time (Shaw and Zamorano 2020). The 5-year intervals used were 2006-2010AVG; 2011-2015AVG; and 2016-2020AVG.

Recent Chloride Concentration Map Development

The recent chloride concentration map is a regional representation of the average chloride concentration in the UFA from 2016 to 2020. Groundwater quality data from the 207 of the Districts' monitoring wells and 266 SJRWMD consumptive use permit (CUP) wells were used for creation of this map. Active monitoring wells were evaluated to determine total depth, casing depth, aquifer penetration, and period of record of available data.

Initial mapping of the 207 District monitoring wells highlighted some limitations in the spatial distribution of wells in the network. The SJRWMD's regional groundwater monitoring network is not specifically designed to monitor or track saltwater intrusion. Therefore, the availability and distribution of wells in the UFA may not be adequate to interpolate the location of the SWI interface.

To supplement the existing SJRWMD monitoring well network data, CUP production wells were used. Several CUP projects in the SJRWMD portion of the NFRWSP region are required to submit water quality data as a condition on their permit. CUP wells in the NFRWSP region were screened for suitability for inclusion in the mapping effort. Priority was given to CUP wells with similar construction to nearby SJRWMD monitor wells, and to wells with the most complete period of record. In well clusters with multiple wells of similar construction and chloride concentrations, one was chosen as representative of the area. The set of suitable CUP wells was limited by data availability.

All 473 wells were used when interpolating the map, even though only 259 wells are located inside the NFRWSP region (116 District monitoring wells and 143 CUP wells). Water quality data from wells outside the planning region were used in interpolation to prevent skewing of contours along the boundary. The final data was clipped to boundary of the NFRWSP for presentation purposes (Figures D7 and D7a; and Table D1).
The chloride concentration values used for each station were computed as follows:

1. For every calendar year (2016 through 2020), the ArcMap *Summary Statistics* tool was run with the following parameters:
    a. Input Table: collection of the chloride concentrations for all the stations over the study period (2016 through 2020).
    b. Statistics Field: Chloride Concentration (mg/L)
        i. Statistics Type: MEAN
    c. Case field: Year

    This was done to eliminate any bias that might occur if a particular station in a given year had multiple measurements over the course of that year.

2. Next, a field Year_Group was created in the resulting table and was set equal to time period (2016 through 2020) for each of the records in the resulting table.

3. The *Summary Statistics* tool was then run on the resulting table with the following parameters:
    a. Input Table: The table resulting from the first running of *Summary Statistics*.
    b. Statistics Field: Yearly Mean of Chloride Concentration (mg/l)
        i. Statistics Type: Mean
    c. Case field: Year_Group (time period)

The values in the *Mean of Mean Value* field in this resulting table were the values used for interpolating the map surface.

<u>The Interpolation Method</u>

Given the uneven distribution of data points, an interpolation method was used to produce the ArcMap surfaces. Since the various available interpolation methods operate differently and produce varying results, various methods were compared to determine which method would best represent the data. After comparing the results from the various methods, the spline interpolation method with the TENSION option and a weight of 5 was selected.

ESRI/ArcMap description of the spline method of raster interpolation (Esri Inc. 2020):

Summary

Interpolates a raster surface from points using a two-dimensional minimum curvature spline technique. The resulting smooth surface passes exactly through the input points.

Usage

- The REGULARIZED option of **Spline type** usually produces smoother surfaces than those created with the TENSION option.
  - With the REGULARIZED option, higher values used for the weight parameter produce smoother surfaces. The values entered for this parameter must be equal to or greater than zero. Typical values used are 0, 0.001, 0.01, 0.1, and 0.5. The **Weight** is the square of the parameter referred to in the literature as tau (t).
  - With the TENSION option, higher values entered for the weight parameter result in somewhat coarser surfaces, but surfaces that closely conform to the control points. The values entered must be equal to or greater than zero. Typical values are 0, 1, 5, and 10. The **Weight** is the square of the parameter referred to in the literature as phi (Φ).
- The greater the value of **Number of Points**, the smoother the surface of the output raster.
- Some input datasets may have several points with the same x,y coordinates. If the values of the points at the common location are the same, they are considered duplicates and have no effect on the output. If the values are different, they are considered coincident.

ArcMap’s *Spline Interpolation Tool* was used to produce the chloride concentration surfaces for the 2016-2020AVG time-period. The following parameters were used:

- Output cell size: 250 meters
- Spline type: TENSION
- Weight: 5
- Number of points: 12

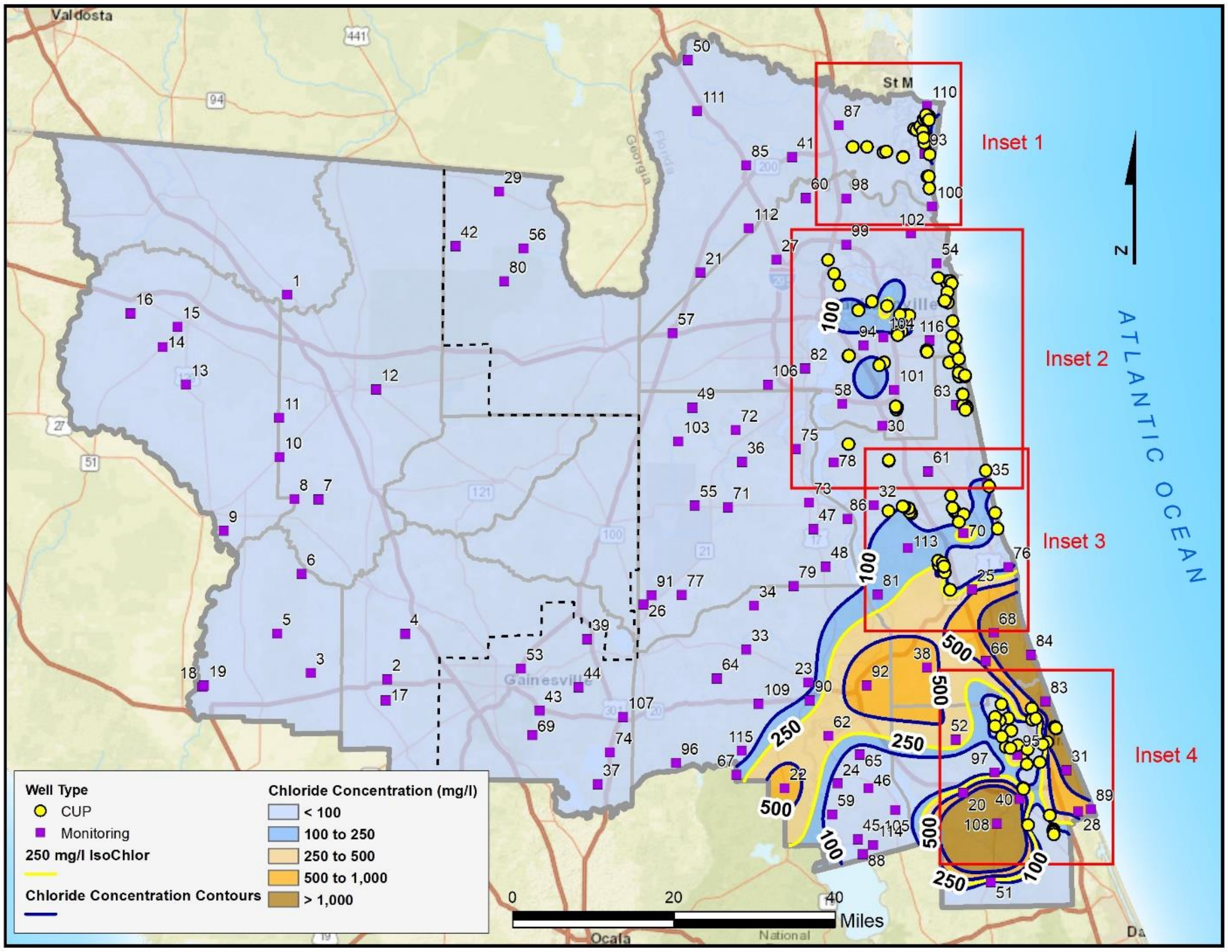

Figure D7. Recent (2016-2020 AVG) chloride concentrations in the Upper Floridan Aquifer Well Index

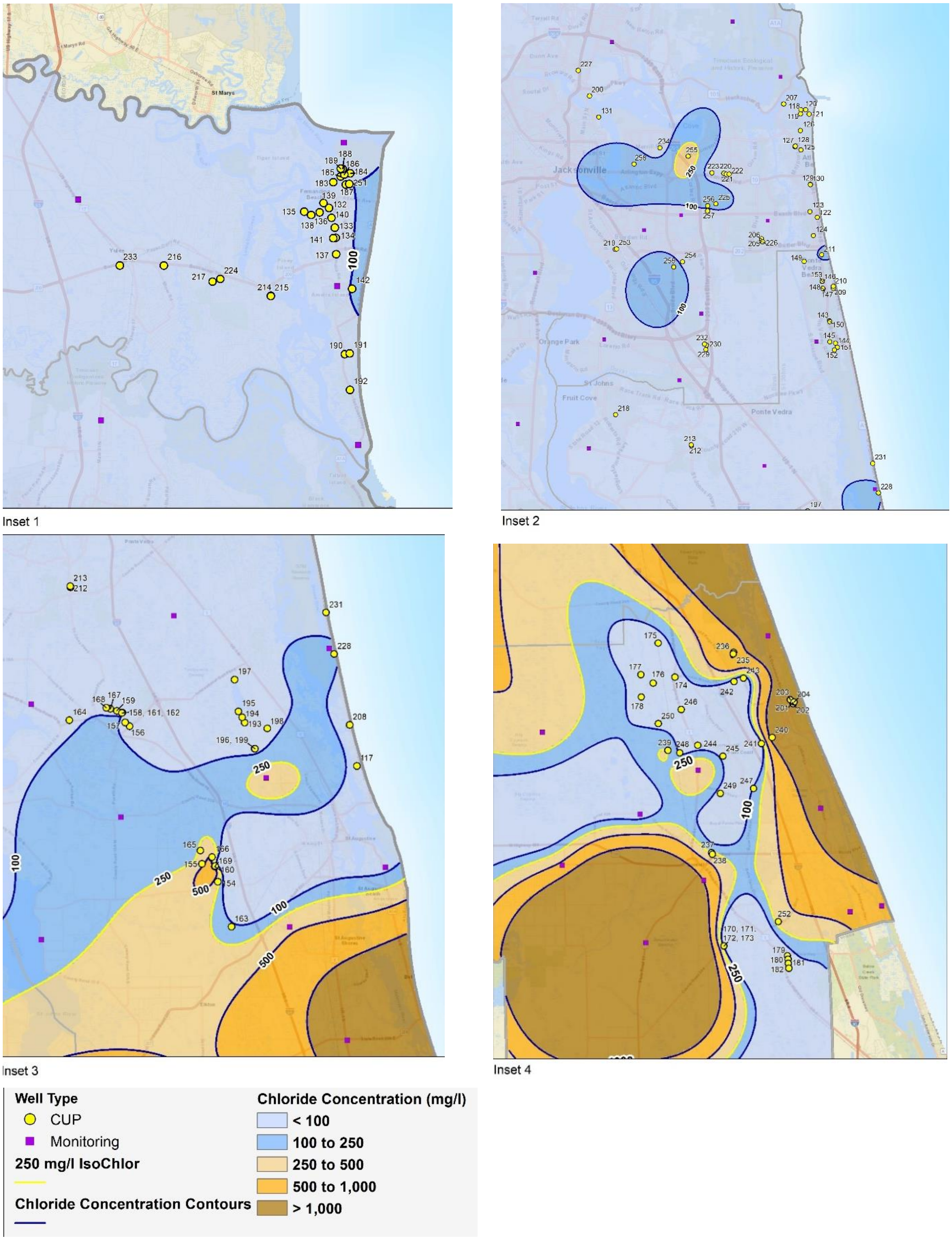

Figure D7a. Figure D7 Well Index Inset Maps

Table D1. Recent (2016-2020 AVG) Chloride Concentration Map Well Index

Map Index Number	Well Name	Chloride Concentration (mg/L)
1	S011535004	7
2	S091736001	6
3	S091628005	4
4	S081833003	13
5	S081535002	5
6	S071630002	7
7	S061610001	6
8	S061607001	5
9	S061434006	11
10	S051511002	6
11	S041523001	4
12	S031734011	6
13	S031335002	4
14	S031305005	6
15	S021322008	6
16	S021215001	6
17	S101713003	6
18	S101406011	9
19	S101405004	9
20	F-0353	612
21	N-0237	20
22	P-0472	656
23	P-0123	42
24	P-0408	17
25	SJ0824	425
26	C-0120	6
27	D-1309	20
28	F-0176	659
29	BA0057	26
30	D-1413	19
31	F-0064	1,225
32	SJ0324	17
33	P-4086	6
34	P-4083	6
35	SJ2574	116
36	C-1063	5
37	A-0725	9
38	SJ0408	587
39	A-0962	12
40	F-0384	974
41	N-0341	26

Map Index Number	Well Name	Chloride Concentration (mg/L)
42	BA0121	14
43	A-0973	24
44	A-0977	7
45	P-0469	43
46	P-0246	9
47	C-1056	5
48	C-1026	6
49	C-0583	6
50	N-0221	30
51	F-0251	37
52	F-0294	386
53	A-0693	9
54	D-1383	79
55	C-0128	7
56	BA0009	9
57	D-0254	8
58	D-1301	10
59	P-0270	10
60	D-1503	25
61	SJ2556	23
62	P-4043	330
63	SJ0355	20
64	P-0772	9
65	P-0817	9
66	SJ0602	631
67	P-0450	160
68	SJ0516	1,444
69	A-0750	8
70	SJ0331	341
71	C-0607	5
72	C-0592	5
73	C-0672	5
74	A-0421	7
75	C-0495	5
76	SJ0323	64
77	C-0453	5
78	SJ0508	6
79	C-0123	6
80	BA0018	10
81	SJ0320	158
82	D-1394	10
83	F-0200	2,033

Map Index Number	Well Name	Chloride Concentration (mg/L)
84	SJ0333	2,819
85	N-0220	28
86	C-0579	9
87	N-0320	29
88	P-0736	59
89	F-0209	848
90	P-0891	169
91	C-0707	5
92	P-0172	755
93	N-0344	27
94	D-1499	14
95	F-0208	427
96	P-0166	5
97	F-0395	18
98	D-0673	24
99	D-1307	21
100	N-0347	23
101	D-1350	17
102	D-1236	22
103	C-0599	5
104	D-0547	16
105	P-2037	25
106	D-1292	6
107	A-0071	10
108	F-0179	5,956
109	P-0510	6
110	N-0304	31
111	N-0334	27
112	N-0311	26
113	SJ0027	192
114	P-0410	24
115	P-0132	5
116	D-0259	12
117	15022	74
118	5924	27
119	5925	27
120	5926	17
121	33450	16
122	6342	18
123	6345	12
124	32013	11
125	6378	16

Map Index Number	Well Name	Chloride Concentration (mg/L)
126	6379	16
127	6381	16
128	6383	16
129	6413	38
130	6414	46
131	6441	13
132	11387	31
133	11391	30
134	11392	39
135	11393	40
136	11397	27
137	11398	26
138	11399	27
139	11400	36
140	11401	44
141	480689	26
142	11434	114
143	14640	23
144	14641	24
145	14642	24
146	14818	49
147	14819	46
148	14820	30
149	14822	26
150	15110	25
151	24083	25
152	24084	23
153	33882	39
154	14780	313
155	34243	409
156	34244	30
157	34245	33
158	34246	27
159	34247	28
160	35768	503
161	36325	26
162	36326	41
163	36327	128
164	36341	63
165	38399	289
166	38400	454
167	461256	27

Map Index Number	Well Name	Chloride Concentration (mg/L)
168	461257	39
169	484406	342
170	409798	31
171	409799	60
172	409800	8
173	409801	37
174	409815	38
175	409821	19
176	409822	56
177	409823	67
178	409824	66
179	6747	32
180	6748	24
181	6749	23
182	31977	27
183	11379	68
184	11381	40
185	11383	73
186	11384	52
187	11386	42
188	451851	32
189	451852	31
190	11419	23
191	11420	25
192	11406	22
193	995	52
194	996	51
195	997	51
196	39707	60
197	237545	42
198	237546	65
199	237548	60
200	35679	17
201	35974	1,780
202	35975	1,660
203	35976	1,690
204	36317	1,630
205	6081	13
206	6082	13
207	6208	15
208	14699	71
209	14726	27

Map Index Number	Well Name	Chloride Concentration (mg/L)
210	14727	24
211	14728	118
212	15112	40
213	15114	30
214	19912	23
215	19913	22
216	19914	23
217	19915	22
218	22058	17
219	22526	21
220	22567	38
221	22568	17
222	22569	16
223	34485	16
224	35838	22
225	38532	198
226	38606	14
227	38608	17
228	105544	106
229	223642	42
230	230916	18
231	243339	41
232	407883	18
233	407885	25
234	409701	28
235	WU070714033562	876
236	WU070714033563	986
237	WU001982040148	247
238	WU001982406338	288
239	WU001947409789	240
240	WU001947409805	1,200
241	WU001947409806	45
242	WU001947409809	35
243	WU001947409810	27
244	WU001947409811	24
245	WU001947409812	45
246	WU001947409813	33
247	WU001947409814	110
248	WU001947409816	85
249	WU001947409819	40
250	WU001947409820	65
251	Rock Tenn 50077_11380	81

Map Index Number	Well Name	Chloride Concentration (mg/L)
252	Flag Bch 59_34525	306
253	JEA Brierwood 88271_22525	23
254	JEA Deerwood 3 88271_22540	60
255	Monument-2 88271_5894	329
256	JEA Oakridge 88271_6060	187
257	JEA Oakridge 88271_6063	24
258	JEA Arlington 88271_6087	207
259	JEA Deerwood 3 88271_6097	177

Movement of the Saltwater Interface Map Development

Evaluation of CUP wells for filling the data gaps revealed that many CUP wells met the well construction criteria suitable for development of the recent concentration map but a more limited dataset was used in the comparison maps due to a lack of data in all three-time intervals. A consistent data set is critical for comparison mapping as the addition or removal of wells may alter the position of the mapped contours without an actual change in concentration and complicate interpretation of the movement of the SWI. Only stations common to all three time periods were used in the development of the comparison map series for a total of 213 wells (207 District monitoring wells and 6 CUP wells). All of the 213 common wells were used in interpolating the maps, with 107 wells (101 District monitoring wells and 6 CUP wells) located inside the boundary of the NFRWSP. Water quality data from wells outside the planning region were used in interpolation to prevent skewing of contours along the boundary. The final data was clipped to boundary of the NFRWSP for presentation purposes.

The chloride concentration values used for each station in each time-period were computed by:

1. For every calendar year in the study (2006 through 2020), the ArcMap *Summary Statistics* tool was run with the following parameters:
    a. Input Table: collection of the chloride concentrations for all the stations over the entire study period (2006 through 2020).
    b. Statistics Field: Chloride Concentration (mg/l)
        i. Statistics Type: MEAN
    c. Case field: Year

    This was done to eliminate any bias that might occur if a particular station in a given year had multiple measurements over the course of that year.

2. Next, a field Year_Group was created in the resulting table and was set equal to time period (“2006 to 2010”, “2011 to 2015”, “2016 to 2020”) for each of the records in the resulting table.

3. The *Summary Statistics* tool was then run on the resulting table with the following parameters:
    a. Input Table: The table resulting from the first running of *Summary Statistics*.
    b. Statistics Field: Yearly Mean of Chloride Concentration (mg/l)
        i. Statistics Type: Mean
    c. Case field: Year_Group (time period)

The values in the *Mean of Mean Value* field in this resulting table were the values used for interpolating the map surfaces.

Consistent with the comparison maps the surface was created using the spline interpolation method with the TENSION option and a weight of five.

ArcMap's *Spline Interpolation Tool* was used to produce the chloride concentration surfaces for the time period. The following parameters were used:

- Output cell size: 250 meters
- Spline type: TENSION
- Weight: 5
- Number of points: 12

For each concentration map produced (2006-2010AVG; 2011-2015AVG; and 2016-2020AVG), ArcMap's *Contour Tool* was used to create all the chloride concentration isolines (isochlors) using the chloride concentration surfaces as input rasters. The 250 mg/L isochlor for each time segment was then displayed on a single map. See Figure D8 and Table D2.

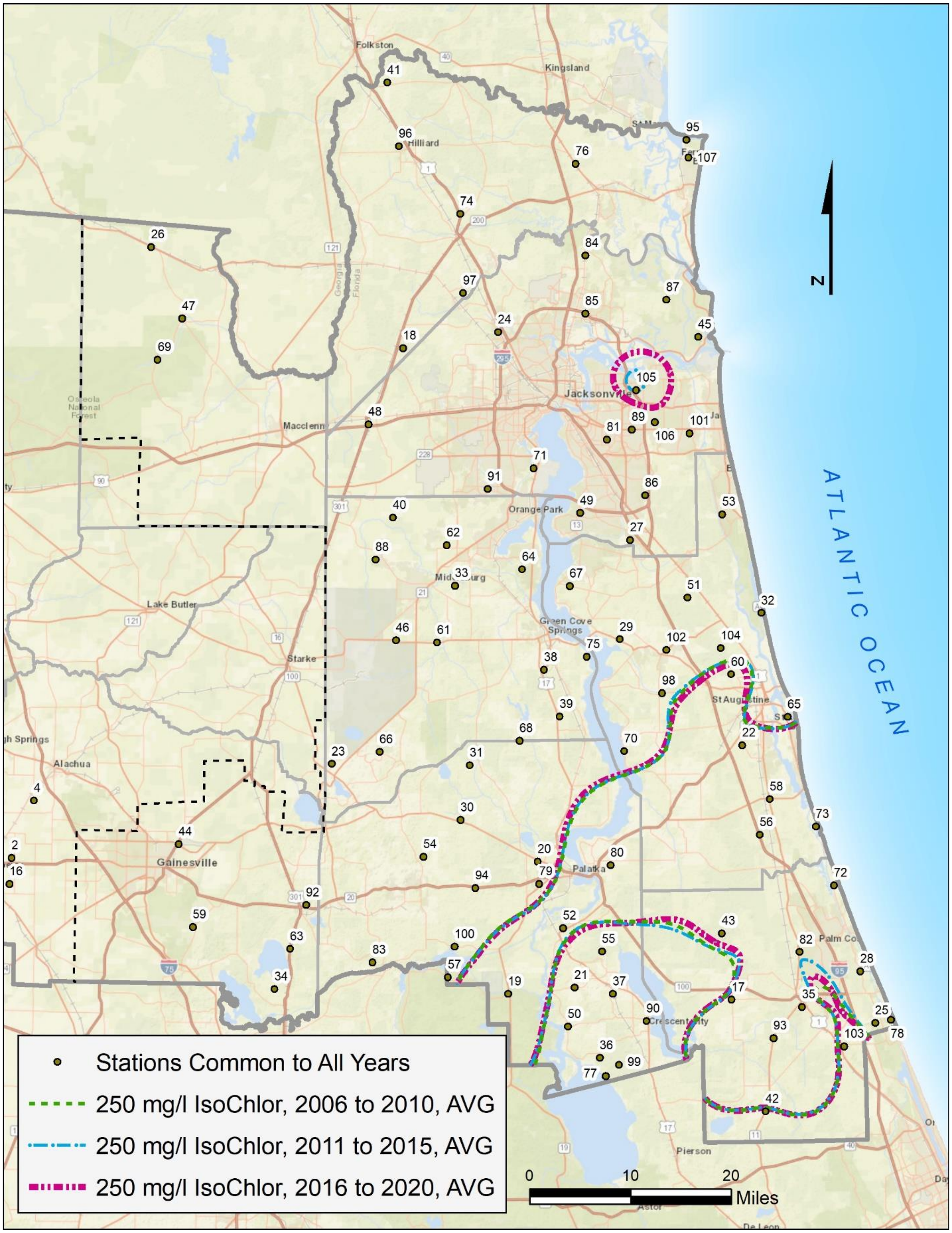

Figure D8. Movement of the Saltwater Interface in the Upper Floridan Aquifer Well Index

Table D2. Movement of the Saltwater Interface in the Upper Florida Aquifer Well Index

Map Index Number	Well Name	Mean Chloride Concentration (mg/L) 2006-2010	Mean Chloride Concentration (mg/L) 2011-2015	Mean Chloride Concentration (mg/L) 2016-2020
1	S011535004	6	7	7
2	S091736001	6	6	6
3	S091628005	5	5	4
4	S081833003	13	14	13
5	S081535002	5	5	5
6	S071630002	5	6	7
7	S061610001	5	6	6
8	S061607001	4	5	5
9	S061434006	14	12	11
10	S051511002	5	6	6
11	S031734011	5	6	6
12	S031335002	3	4	4
13	S031305005	5	7	6
14	S021322008	4	5	6
15	S021215001	5	6	6
16	S101713003	5	6	6
17	F-0353	587	550	612
18	N-0237	19	19	20
19	P-0472	701	691	656
20	P-0123	37	43	42
21	P-0408	7	7	17
22	SJ0824	404	382	425
23	C-0120	6	9	6
24	D-1309	18	18	20
25	F-0176	640	602	659
26	BA0057	26	26	26
27	D-1413	17	20	19
28	F-0064	1,211	1,068	1,225
29	SJ0324	16	17	17
30	P-4086	6	8	6
31	P-4083	5	8	6
32	SJ2574	115	120	116
33	C-1063	4	7	5
34	A-0725	9	10	9
35	F-0384	952	995	974
36	P-0469	59	53	43
37	P-0246	8	9	9
38	C-1056	5	7	5
39	C-1026	5	7	6

Map Index Number	Well Name	Mean Chloride Concentration (mg/L) 2006-2010	Mean Chloride Concentration (mg/L) 2011-2015	Mean Chloride Concentration (mg/L) 2016-2020
40	C-0583	5	7	6
41	N-0221	28	29	30
42	F-0251	35	36	37
43	F-0294	502	482	386
44	A-0693	8	9	9
45	D-1383	184	63	79
46	C-0128	6	9	7
47	BA0009	9	10	9
48	D-0254	35	8	8
49	D-1301	11	12	10
50	P-0270	9	10	10
51	SJ2556	21	24	23
52	P-4043	306	301	330
53	SJ0355	18	19	20
54	P-0772	8	10	9
55	P-0817	9	10	9
56	SJ0602	605	624	631
57	P-0450	155	161	160
58	SJ0516	1,792	1,699	1,444
59	A-0750	6	8	8
60	SJ0331	413	423	341
61	C-0607	4	6	5
62	C-0592	4	7	5
63	A-0421	7	8	7
64	C-0495	4	7	5
65	SJ0323	59	62	64
66	C-0453	4	7	5
67	SJ0508	5	7	6
68	C-0123	6	8	6
69	BA0018	10	10	10
70	SJ0320	161	162	158
71	D-1394	9	11	10
72	F-0200	1,966	1,990	2,033
73	SJ0333	2,610	2,754	2,819
74	N-0220	25	25	28
75	C-0579	8	9	9
76	N-0320	28	28	29
77	P-0736	61	61	59
78	F-0209	1,006	981	848
79	P-0891	170	170	169

Map Index Number	Well Name	Mean Chloride Concentration (mg/L) 2006-2010	Mean Chloride Concentration (mg/L) 2011-2015	Mean Chloride Concentration (mg/L) 2016-2020
80	P-0172	693	703	755
81	D-1499	14	15	14
82	F-0208	668	283	427
83	P-0166	5	6	5
84	D-0673	20	22	24
85	D-1307	19	20	21
86	D-1350	16	17	17
87	D-1236	20	21	22
88	C-0599	4	5	5
89	D-0547	16	16	16
90	P-2037	23	24	25
91	D-1292	5	7	6
92	A-0071	11	10	10
93	F-0179	5,787	5,643	5,956
94	P-0510	6	7	6
95	N-0304	30	29	31
96	N-0334	25	25	27
97	N-0311	23	24	26
98	SJ0027	203	213	192
99	P-0410	19	26	24
100	P-0132	5	6	5
101	D-0259	11	12	12
102	WU001198034244	30	39	30
103	WU001960006748	27	22	24
104	WU050299000995	64	51	52
105	WU088271005894	189	254	329
106	WU088271038532	50	59	174
107	WU050077011380	44	63	83

2021 Annual Assessment of Districts' Monitoring Networks – Status and Trends

Water quality monitoring provides a wealth of information to enable SJRWMD and SRWMD to accomplish their core mission of protecting the environment and restoring water quality. This water quality data helps to determine the health of groundwater, springs, rivers, and estuaries. Implemented in the 1980s, the SJRWMD water quality monitoring network includes over 450 groundwater stations throughout its entire 18-county District. The SRWMD water quality monitoring network was established in the 1970's and currently includes 106 groundwater stations throughout its entire 15-county District. Water quality data from these monitoring wells are obtained from samples collected by District staff and analyzed for a variety of water quality parameters using U.S. Environmental Protection Agency (EPA) methods.

The monitoring wells analyzed in this section consists of 97 SJRWMD wells and 20 SRWMD wells within the NFRWSP area. This analysis focuses on the water quality status and trend of chloride and TDS. The method briefly explained below applies to the network of wells from both Districts.

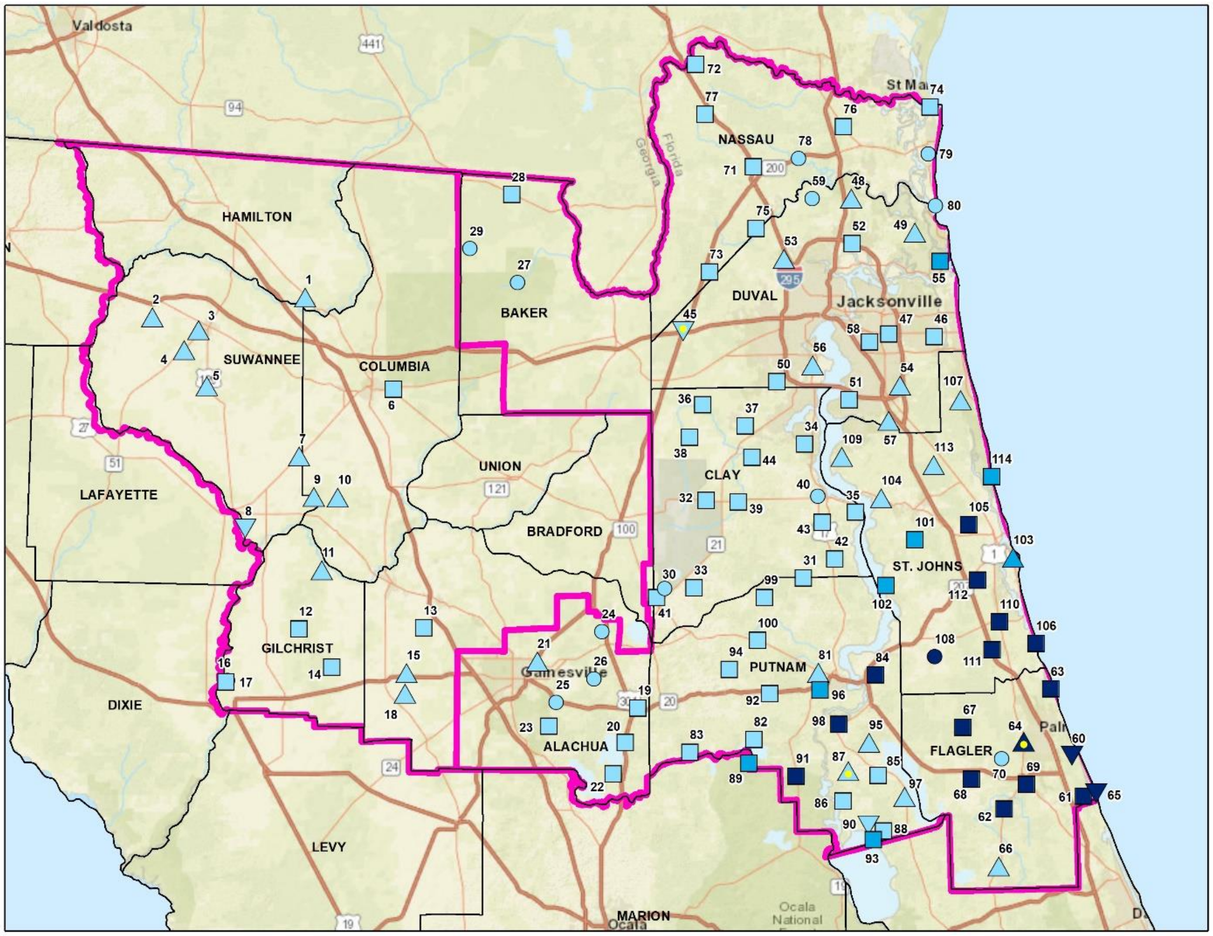

Figure D9. 2021 Annual Assessment of District Monitoring Networks – Status and Trends Well Index

Table D3. 2021 Annual Assessment of District Monitoring Networks – Status and Trends Well Index

Map Index	Station	Station ID
1	S011535004	NA
2	S021215001	NA
3	S021322008	NA
4	S031305005	NA
5	S031335002	NA
6	S031734011	NA
7	S051511002	NA
8	S061434006	NA
9	S061607001	NA
10	S061610001	NA
11	S071630002	NA
12	S081535002	NA

Map Index	Station	Station ID
13	S081833003	NA
14	S091628005	NA
15	S091736001	NA
16	S101405004	NA
17	S101406011	NA
18	S101713003	NA
19	A-0071	58028
20	A-0421	79502
21	A-0693	58039
22	A-0725	58056
23	A-0750	73511
24	A-0962	410566
25	A-0973	439915
26	A-0977	453044
27	BA0018	59128
28	BA0057	59162
29	BA0121	425707
30	C-0120	58958
31	C-0123	58961
32	C-0128	58976
33	C-0453	58892
34	C-0495	76637
35	C-0579	56611
36	C-0583	56620
37	C-0592	79007
38	C-0599	79155
39	C-0607	39625
40	C-0672	406450
41	C-0707	425102
42	C-1026	56615
43	C-1056	56612
44	C-1063	74516
45	D-0254	58680
46	D-0259	61025
47	D-0547	58702
48	D-0673	58710
49	D-1236	74275
50	D-1292	59539
51	D-1301	61029
52	D-1307	59482

Map Index	Station	Station ID
53	D-1309	59483
54	D-1350	78617
55	D-1383	39693
56	D-1394	56626
57	D-1413	74705
58	D-1499	406258
59	D-1503	409608
60	F-0064	76641
61	F-0176	58478
62	F-0179	39655
63	F-0200	58347
64	F-0208	150817
65	F-0209	161390
66	F-0251	58360
67	F-0294	58384
68	F-0353	58414
69	F-0384	241516
70	F-0395	435184
71	N-0220	57731
72	N-0221	57733
73	N-0237	57752
74	N-0304	39643
75	N-0311	39653
76	N-0320	105736
77	N-0334	242724
78	N-0341	244362
79	N-0344	431088
80	N-0347	453636
81	P-0123	57434
82	P-0132	74657
83	P-0166	76626
84	P-0172	57453
85	P-0246	57462
86	P-0270	57472
87	P-0408	57515
88	P-0410	57519
89	P-0450	57393
90	P-0469	57399
91	P-0472	57406
92	P-0510	57312

Map Index	Station	Station ID
93	P-0736	57349
94	P-0772	57286
95	P-0817	57292
96	P-0891	57243
97	P-2037	57188
98	P-4043	57148
99	P-4083	71778
100	P-4086	71777
101	SJ0027	57012
102	SJ0320	76634
103	SJ0323	76644
104	SJ0324	76645
105	SJ0331	73521
106	SJ0333	71774
107	SJ0355	105292
108	SJ0408	411235
109	SJ0508	56959
110	SJ0516	56961
111	SJ0602	56933
112	SJ0824	56921
113	SJ2556	56869
114	SJ2574	66008

Water quality status

The status assessment period was five years, extending from January 1, 2016, to December 31, 2020. At least three years of data during the five-year period were required to complete the status assessment, and the last year had to be 2020. In the analyses, the water quality status was represented by the median of the annual values from the five-year assessment period. Median values were chosen to represent water quality status, since they are not skewed by outliers, making them robust indicators of central tendency.

Ranges in water quality status were developed for chloride and Total Dissolved Solids (TDS) concentrations. The range was not based on a percentile distribution, but rather a numerical range. As a note, all ranges are expressed as low, medium, or high relative to each other, and high values do not necessarily indicate poor water quality.

Chloride Relative status

- Low (less than 50 mg/L)
- Medium (50 - 250 mg/L)
- High (greater than 250 mg/L

TDS Relative status

- Low (less than 250 mg/L)
- Medium (250 - 500 mg/L)
- High (greater than 500 mg/L)

Water quality trends

The assessment period for the trend analysis was 15 years, extending from January 1, 2006, to December 31, 2020. At least 10 years of data during this period were required to complete the analysis, and the last year had to be 2020. A given set of time series data that does not satisfy these criteria is considered to be insufficient. Insufficient data are not analyzed any further as their number of records are limited. In the presentation of results tables, such stations are classified as *insufficient data*. The assessment of the monitoring wells incorporated non-detect (ND) techniques using R code, as found in the NADA package for R programming software (Lopaka, 2020). Summary statistics were calculated using the *cenfit* function, while trend data were calculated using the *cenken* command. Results from ND techniques were only reported for those stations with more than 5% ND.

The Mann Kendall test (MKR) was used for trend assessment. Trend slopes were determined with the Sen slope method. If there were seasonality between seasons (months) as determined by the Kruskal Wallis test ($p<0.05$), then the seasonal version of the Mann Kendall test was used.

Trends indicate what has happened at a given water quality well over the assessment period. Water quality trend categories were developed to indicate whether the trend was increasing or decreasing and also identified those wells with trends that are changing more than 5% per year. Wells with statistically non-significant trends were given a separate designation as were wells with insufficient data. Stations may have insufficient data for a variety of reasons.

Additionally, the relative magnitude of statistically significant trends in chloride concentration was assigned for tabulated data to quantify the potential for saltwater intrusion:

- Low rate: *slope* < 1.0 mg/L/yr
- Medium rate: 3.0 mg/L/yr < *slope* > 1.0 mg/L/yr
- High rate: *slope* > 3.0 mg/L/yr

SRWMD Monitoring Wells Analysis

Twenty (20) monitoring wells were used for the current status and trend analysis (Table D4). The results of the analyses are summarized by county in Tables D5a and D5b for chlorides and TDS, respectively.

From the last row of Table D5a, 12 (67%) of the wells analyzed appear to be increasing in trend, 5 (28%) of the wells are stable, and only one (5%) well shows a decrease in trend in chloride concentration. In terms of status, all 19 of the wells analyzed have low chloride concentrations The TDS concentration in Table D5b, shows seven (39%) of the wells are increasing, while 10 (56%) of the wells are found to be stable. Only one (5%) well shows a decrease in trend. In terms of status, 10 (56%) of the wells were in low TDS concentration and eight (44%) of the wells have a medium concentration. None of the wells had reached a high TDS concentration. Detailed results for each well are shown in Tables D6a and D6b for chloride and TDS, respectively.

With respect to water quality status, chloride concentration does not appear to indicate a threat to the drinking water standards (250 mg/L). Chloride concentrations are extremely low, with about 60% of the wells showing rise in trend. TDS concentrations are a mix of low and medium; about 30% of the wells show a rise in trend at a higher rate of change, on the average, than chloride.

Table D4: SRWMD Monitoring wells used for the MKR Trend Analysis

	Chloride			TDS			
Station	Start Date	End Date	No. of Years	Start Date	End Date	No. of Years	Aquifer
S010920002	1/4/2006	7/28/2020	15	1/4/2006	7/28/2020	15	UFA
S011535004	2/1/2006	7/28/2020	14	2/1/2006	7/28/2020	15	UFA
S021215001	2/2/2006	11/5/2020	15	2/2/2006	11/5/2020	15	UFA
S021322008	2/1/2006	11/5/2020	14	2/1/2006	11/5/2020	14	UFA
S031035001	1/42006	11/16/2020	14	1/4//2006	11/16/2020	15	UFA
S031305005	2/2/2006	11/5/2020	15	2/2/2006	11/5/2020	15	UFA
S031335002	2/2/2006	11/5/2020	15	2/2/2006	11/5/2020	15	UFA
S031734011	3/2/2006	7/28/2020	12	3/2/2006	7/28/2020	12	UFA
S051511002	3/2/2006	7/29/2020	14	3/2/2006	7/29/2020	14	UFA
S061434006	2/2/2006	12/14/2020	15	2/2/2006	3/11/2020	15	UFA
S061607001	3/2/2006	11/23/2020	15	3/2/2006	8/12/2020	15	UFA
S061610001	3/2/2006	11/23/2020	15	3/2/2006	8/12/2020	15	UFA
S071630002	1/4/2006	3/12/2020	14	1/4/2006	3/12/2020	13	UFA
S081535002	7/6/2006	3/12/2020	14	7/6/2006	3/12/2020	14	UFA
S081833003	2/8/2006	12/14/2020	13	2/8/2006	3/11/2020	12	UFA
S091628005	1/4/2006	11/24/2020	15	1/4/2006	11/24/2020	15	UFA
S091736001	2/8/2006	12/14/2020	13	2/8/2006	3/11/2020	13	UFA
S101405004	3/15/2011	11/24/2020	9	3/15/2011	11/24/2020	9	UFA
S101406011	3/15/2011	11/24/2020	10	3/15/2011	11/24/2020	9	UFA
S101713003	2/8/2006	12/14/2020	13	2/8/2006	3/11/2020	13	UFA

Table D5a – Chloride Trend and Status summary for counties in SRWMD

	Trend				Status			
County	**No of decreasing wells**	**No of stable wells**	**No of increasing wells**	**No of insufficient data**	**No of wells at low concentration**	**No of wells at medium concentration**	**No of wells at High concentration**	**No of wells with insufficient data**
Gilchrist	0	2	2	2	5	0	0	1
Hamilton	0	0	1	0	1	0	0	0
Suwannee	1	1	4	0	6	0	0	0
Columbia	0	1	3	0	4	0	0	0
Alachua	0	1	2	0	3	0	0	0
Total	**1**	**5**	**12**	**2**	**19**	**0**	**0**	**1**

Table D5b – TDS Trend and Status summary for counties in SRWMD

	Trend				Status			
County	**No of decreasing wells**	**No of stable wells**	**No of increasing wells**	**No of insufficient data**	**No of wells at low concentration**	**No of wells at medium concentration**	**No of wells at High concentration**	**No of wells with insufficient data**
Gilchrist	0	2	2	2	4	0	0	2
Hamilton	0	1	0	0	0	1	0	0
Suwannee	1	3	2	0	2	4	0	0
Columbia	0	2	2	0	2	2	0	0
Alachua	0	2	1	0	2	1	0	0
Total	**1**	**10**	**7**	**2**	**10**	**8**	**0**	**2**

Table D6a: Chloride trend and status for selected SRWMD Monitoring wells

Well			POR		Statistics					Mann-Kendall test			
Station	County	Aquifer	Start	End	No. of obs.	Min (mg/L)	Max (mg/L)	Median (mg/L)	Status	Slope (mg/L/yr)	P-value	Trend	Rate of change
S010920002	Gilchrist	UFA	1/4/2006	7/28/2020	36	4.000	7.43	5.760	Low	0.077	0.0001	Increasing	Low
S011535004	Hamilton	UFA	2/1/2006	7/28/2020	37	4.889	13.40	6.200	Low	0.105	0.0005	Increasing	Low
S021215001	Suwannee	UFA	2/2/2006	11/5/2020	38	3.700	14.10	5.465	Low	0.135	0.0046	Increasing	Low
S021322008	Suwannee	UFA	2/1/2006	11/5/2020	39	3.000	7.20	4.840	Low	0.094	0.0013	Increasing	Low
S031035001	Suwannee	UFA	1/4/2006	11/16/2020	55	2.590	10.00	6.643	Low	0.072	0.0610	Stable	Low
S031305005	Suwannee	UFA	2/2/2006	11/5/2020	39	0.500	8.29	5.400	Low	0.123	0.0028	Increasing	Low
S031335002	Suwannee	UFA	2/2/2006	11/5/2020	39	2.420	5.31	3.400	Low	0.051	0.0092	Increasing	Low
S031734011	Columbia	UFA	3/2/2006	7/28/2020	29	4.000	7.47	5.300	Low	0.063	0.1323	Stable	Low
S051511002	Columbia	UFA	3/2/2006	7/29/2020	33	4.000	8.40	5.200	Low	0.079	0.0377	Increasing	Low
S061434006	Suwannee	UFA	2/2/2006	12/14/2020	39	9.357	17.10	13.000	Low	-0.313	0.0000	Decreasing	Low
S061607001	Columbia	UFA	3/2/2006	11/23/2020	58	3.000	6.73	4.700	Low	0.081	0.0003	Increasing	Low
S061610001	Columbia	UFA	3/2/2006	11/23/2020	57	4.000	7.86	5.920	Low	0.082	0.0247	Increasing	Low
S071630002	Gilchrist	UFA	1/4/2006	3/12/2020	36	3.000	10.40	5.535	Low	0.138	0.0012	Increasing	Low
S081535002	Gilchrist	UFA	7/6/2006	3/12/2020	34	4.000	6.50	4.950	Low	0.038	0.1220	Stable	Low
S081833003	Alachua	UFA	2/8/2006	12/14/2020	32	10.241	15.30	13.250	Low	0.064	0.3630	Stable	Low
S091628005	Gilchrist	UFA	1/4/2006	11/24/2020	51	3.000	6.38	4.580	Low	-0.009	0.5917	Stable	Low
S091736001	Alachua	UFA	2/8/2006	12/14/2020	33	4.700	7.71	5.700	Low	0.053	0.0371	Increasing	Low
S101405004	Gilchrist	UFA	3/15/2011	11/24/2020	30	2.544	11.45	9.780	Insufficient Data				
S101406011	Gilchrist	UFA	3/15/2011	11/24/2020	34	2.376	10.14	9.110	Low	0.074	0.1820	Stable	Low
S101713003	Alachua	UFA	2/8/2006	12/14/2020	28	4.000	7.32	5.210	Low	0.084	0.0305	Increasing	Low

Table D6b: TDS trend and status for selected SRWMD Monitoring wells

Well			POR		Statistics					Mann-Kendall test results			
Station	**County**	**Aquifer**	**Start**	**End**	**No. of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
S010920002	Gilchrist	UFA	1/4/2006	7/28/2020	35	187.000	226.000	200.000	Low	1.434	0.0058	Increasing	Medium
S011535004	Hamilton	UFA	2/1/2006	7/28/2020	34	271.000	314.000	285.500	Medium	-0.547	0.3424	Stable	Low
S021215001	Suwannee	UFA	2/2/2006	11/5/2020	37	246.000	323.500	290.000	Medium	-0.520	0.5646	Stable	Low
S021322008	Suwannee	UFA	2/1/2006	11/5/2020	37	303.000	457.000	366.000	Medium	1.620	0.4881	Stable	Medium
S031035001	Suwannee	UFA	1/4/2006	11/16/2020	53	202.000	290.000	221.000	Low	0.129	0.6016	Stable	Low
S031305005	Suwannee	UFA	2/2/2006	11/5/2020	39	279.000	391.000	326.000	Medium	5.171	0.0000	Increasing	High
S031335002	Suwannee	UFA	2/2/2006	11/5/2020	36	181.500	229.000	201.500	Low	1.193	0.0313	Increasing	Medium
S031734011	Columbia	UFA	3/2/2006	7/28/2020	29	183.000	207.000	190.000	Low	-0.249	0.3766	Stable	Low
S051511002	Columbia	UFA	3/2/2006	7/29/2020	33	261.000	316.667	276.000	Medium	2.564	0.017	Increasing	Medium
S061434006	Suwannee	UFA	2/2/2006	12/14/2020	36	270.000	338.000	296.500	Medium	-1.734	0.0092	Decreasing	Medium
S061607001	Columbia	UFA	3/2/2006	11/23/2020	53	170.000	223.000	187.000	Low	1.850	0.0000	Increasing	Medium
S061610001	Columbia	UFA	3/2/2006	11/23/2020	54	255.000	310.000	270.000	Medium	0.639	0.0861	Stable	Low
S071630002	Gilchrist	UFA	1/4/2006	3/12/2020	31	140.000	183.000	153.000	Low	0.898	0.0445	Increasing	Low
S081535002	Gilchrist	UFA	7/6/2006	3/12/2020	31	218.000	264.000	238.000	Low	0.828	0.3156	Stable	Low
S081833003	Alachua	UFA	2/8/2006	12/14/2020	27	208.000	269.000	236.000	Medium	1.393	0.1819	Stable	Medium
S091628005	Gilchrist	UFA	1/4/2006	11/24/2020	50	128.145	192.000	145.000	Low	-0.275	0.3153	Stable	Low
S091736001	Alachua	UFA	2/8/2006	12/14/2020	27	200.000	468.000	210.000	Low	1.719	0.0205	Increasing	Medium
S101405004	Gilchrist	UFA	3/15/2011	11/24/2020	27	245.000	360.000	289.000	Insufficient Data				
S101406011	Gilchrist	UFA	3/15/2011	11/24/2020	30	322.153	618.000	429.500	Insufficient Data				
S101713003	Alachua	UFA	2/8/2006	12/14/2020	24	164.000	436.000	178.500	Low	0.682	0.3438	Stable	Low

SJRWMD Monitoring Wells Analysis

Ninety-seven monitoring wells were used for the current status and trend analysis. The results are summarized by county in Tables D7a and D7b for chlorides and TDS, respectively. Table D7a shows that 21% of the wells have an increasing trend in chloride concentrations while 72% of the wells were stable. This same table shows that 72% of the monitoring wells have low chloride concentrations while 20% have high chloride concentrations, i.e., above the 250 mg/L limit. With respect to TDS concentration, Table D7b shows that only 10% of the monitoring wells showed an increasing trend, while 84% were stable. Twenty-five percent of the wells had a high concentration (above 500 mg/L) and 34% had a low concentration (below 250 mg/l). The remaining 41% of the wells fall between 250 and 500 mg/L. Tables D8a through D17b give a detailed output of the analyses by county.

Table D7a: Chloride Trend and Status summary for counties in SJRWMD

	Trend				Status			
County	**No. of Decreasing wells**	**No. of Stable wells**	**No. of Increasing wells**	**No. of wells Insufficient Data**	**No. of wells at Low concentration**	**No. of wells at Medium concentration**	**No. of wells at High concentration**	**No of wells Insufficient data**
Alachua	1	4	0	3	5	0	0	3
Baker	0	2	0	2	2	0	0	2
Clay	0	13	0	2	13	0	0	2
Duval	1	7	6	1	14	0	0	1
Flagler	2	6	2	1	1	0	9	1
Nassau	0	7	0	3	7	0	0	3
Putnam	1	14	5	0	14	3	3	0
St Johns	0	8	5	1	4	4	5	1
Total	**5**	**61**	**18**	**13**	**60**	**7**	**17**	**13**

Table D7b: TDS Trend and Status summary for counties in SJRWMD

	Trend				Status			
County	**No. of Decreasing wells**	**No. of Stable wells**	**No. of Increasing wells**	**No. of wells insufficient Data**	**No. of wells at Low concentration.**	**No. of wells at Medium concentration**	**No. of wells at High concentration**	**No. of wells Insufficient data**
Alachua	0	4	1	3	4	1	0	3
Baker	0	2	0	2	1	1	0	2
Clay	0	9	0	2	8	1	0	2
Duval	1	11	0	1	0	12	0	1
Flagler	2	7	1	1	0	1	9	1
Nassau	0	7	0	3	0	7	0	3
Putnam	1	14	5	0	12	5	3	0
St Johns	0	9	1	1	1	2	7	1
Total	**4**	**63**	**8**	**13**	**26**	**30**	**19**	**13**

Table D8a: Chloride trend and status for Alachua County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
A-0071	6/14/2006	8/10/2020	22	7.209	18	10.3	Low	0.0969	0.5728	Stable	Low
A-0421	6/14/2006	8/10/2020	23	5.716	11.59	7.24	Low	0.0755	0.107	Stable	Low
A-0693	6/14/2006	8/11/2020	21	6.49	10.39	8.63	Low	0.1274	0.0274	Increasing	Low
A-0725	6/14/2006	8/10/2020	20	6.64	13.57	9.5	Low	0.1516	0.3301	Stable	Low
A-0750	6/19/2007	8/10/2020	19	4.28	11.6	7.14	Low	0.1651	0.0863	Stable	Low
A-0962	3/3/2014	8/11/2020	7	11.72	15.86	12.31	Insufficient Data				
A-0973	8/4/2014	8/10/2020	9	6.13	28.8	26.63	Insufficient Data				
A-0977	9/29/2015	8/11/2020	6	4.82	10.43	6.295	Insufficient Data				

Table D8b: TDS trend and status for Alachua County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
A-0071	6/14/2006	8/10/2020	22	115	166	150	Low	0.075	0.075	Stable	Low
A-0421	6/14/2006	8/10/2020	23	177	194	184	Low	0.8115	0.8115	Stable	Low
A-0693	6/14/2006	8/11/2020	21	99	237	210.5	Low	0.0014	0.0014	Increasing	Low
A-0725	6/14/2006	8/10/2020	20	120	284	266	Medium	0.5803	0.5803	Stable	Low
A-0750	6/19/2007	8/10/2020	17	115.556	221	185.5	Low	0.387	0.387	Stable	Low
A-0962	3/3/2014	8/11/2020	7	211	250	235.556	Insufficient Data				
A-0973	8/4/2014	8/10/2020	8	327	374	338.25	Insufficient Data				
A-0977	9/29/2015	8/11/2020	6	141	188	170.361	Insufficient Data				

Table D9a: Chloride trend and status for Monitoring wells in Baker County (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
BA0009	2/13/2006	9/14/2020	12	7.95	10.9	9.665	Low	-0.0126	0.7317	Stable	Low
BA0018	2/13/2006	9/14/2020	9	9.126	12.03	10.2	Insufficient Data				
BA0057	2/13/2006	9/14/2020	12	24.5	27.8	26	Low	0.0534	0.6274	Stable	Low
BA0121	3/16/2015	9/14/2020	5	12.189	14.59	13.77	Insufficient Data				

Table D9b: TDS trend and status for Monitoring wells in Baker County (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
BA0009	2/13/2006	9/14/2020	12	211	266	223.889	Low	1.4764	0.3359	Stable	Medium
BA0018	2/13/2006	9/14/2020	9	218	247	237.5	Insufficient Data				
BA0057	2/13/2006	9/14/2020	12	353.333	398	385	Medium	0	1	stable	Low
BA0121	3/16/2015	9/14/2020	6	240.556	544	267.25	Insufficient Data				

Table D10a: Chloride trend and status for Clay County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
C-0120	5/29/2007	8/18/2020	13	4.944	11.47	6.42	Low	0.0174	1	Stable	Low
C-0123	7/1/2007	7/15/2020	13	4.73	10.39	6.49	Low	-0.0311	0.7603	Stable	Low
C-0128	5/23/2006	8/18/2020	14	5.03	11.05	6.625	Low	0.1121	0.2736	Stable	Low
C-0453	5/23/2006	8/19/2020	13	3.747	8.86	4.48	Low	0.1127	0.2001	Stable	Low
C-0495	2/15/2006	7/20/2020	14	3.594	9.4	4.485	Low	0.0212	0.6614	Stable	Low
C-0579	6/23/2006	7/20/2020	20	6.38	10.64	8.63	Low	0.0926	0.1941	Stable	Low
C-0583	11/8/2006	8/17/2020	12	3.737	8.58	4.835	Low	0.107	0.5371	Stable	Low
C-0592	2/28/2006	8/17/2020	18	3.778	9.21	4.6	Low	0.0364	0.5193	Stable	Low
C-0599	2/15/2006	8/17/2020	19	0.9	9.72	4.45	Low	0.0629	0.4622	Stable	Low
C-0607	5/4/2006	8/18/2020	20	3.692	9.32	4.41	Low	0.0494	0.2697	Stable	Low
C-0672	3/18/2013	7/20/2020	10	3.24	9.08	5.57	Insufficient Data				
C-0707	2/28/2014	8/18/2020	8	3.788	9.52	5.74	Insufficient Data				
C-1026	3/28/2006	7/20/2020	14	4.284	10.11	5.425	Low	0.0588	0.3244	Stable	Low
C-1056	3/28/2006	7/20/2020	13	4.15	9.66	5.01	Low	0.072	0.2464	Stable	Low
C-1063	2/28/2006	8/17/2020	14	3.634	8.66	4.515	Low	0.0178	0.6614	Stable	Low

Table D10b: TDS trend and status for Clay County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
C-0120	5/29/2007	8/18/2020	13	73	105	91.3	Low	0.6425	0.2198	Stable	Low
C-0123	7/1/2007	7/15/2020	12	38	143	125	Low	1.5625	0.4919	Stable	Medium
C-0128	5/23/2006	8/18/2020	14	155	236	184.667	Low	0.2493	0.8694	Stable	Low
C-0453	5/23/2006	8/19/2020	14	45.556	93	81.15	Low	-1.2373	0.3244	Stable	Medium
C-0495	2/15/2006	7/20/2020	16	84	108	98.1	Low	-0.4045	0.3674	Stable	Low
C-0579	11/8/2006	7/20/2020	19	181	513	449	Medium	-1.0224	0.5756	Stable	Medium
C-0607	5/4/2006	8/18/2020	19	73	106	87.778	Low	-0.1212	0.5279	Stable	Low
C-0672	9/23/2013	7/20/2020	10	74.5	116	99.25	Insufficient Data				
C-0707	8/22/2013	8/18/2020	9	70	97	81	Insufficient Data				
C-1026	3/28/2006	7/20/2020	13	107	129	117	Low	0.1899	0.7138	Stable	Low
C-1056	3/28/2006	7/20/2020	13	3	116.111	104	Low	0.1917	0.9027	Stable	Low

Table D11a: Chloride trend and status for Duval County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
D-0254	12/11/2006	9/15/2020	19	6.437	40.6	34.9	Low	-2.5517	0.0026	Decreasing	Medium
D-0259	12/7/2006	8/24/2020	14	9.858	15.269	11.2	Low	0.051	0.7011	Stable	Low
D-0547	12/16/2006	8/24/2020	14	13.645	18.7	15.735	Low	-0.0052	0.9128	Stable	Low
D-0673	12/7/2006	9/22/2020	13	18.8	25.68	21.282	Low	0.3202	0.0028	Increasing	Low
D-1236	12/7/2006	8/24/2020	14	18.4	24.44	21.02	Low	0.1819	0.0086	Increasing	Low
D-1292	12/11/2006	9/16/2020	13	4.33	8.98	5.318	Low	0.0851	0.2215	Stable	Low
D-1301	12/11/2006	7/27/2020	14	8.892	13.7	10.785	Low	-0.0799	0.4434	Stable	Low
D-1307	12/7/2006	9/22/2020	13	18.17	23.96	19.74	Low	0.1076	0.087	Stable	Low
D-1309	12/7/2006	9/21/2020	13	17.1	22.92	17.95	Low	0.1323	0.0041	Increasing	Low
D-1350	3/1/2006	7/28/2020	17	15.6	18.96	16.728	Low	0.0953	0.0168	Increasing	Low
D-1383	5/15/2006	8/25/2020	28	47.5	1,615	59.64	Low	1.4154	0.0505	Stable	Medium
D-1394	7/22/2006	9/16/2020	24	8.001	13.83	9.63	Low	0.1316	0.0161	Increasing	Low
D-1413	12/12/2006	7/27/2020	14	16.7	21.82	18.07	Low	0.1626	0.0285	Increasing	Low
D-1499	5/5/2010	8/24/2020	18	12.395	17.84	13.95	Low	0.0995	0.0686	Stable	Low
D-1503	6/29/2011	8/12/2020	13	22.06	26.39	23.78	Insufficient Data				

Table D11b: TDS trend and status for Duval County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
D-0254	12/11/2006	9/15/2020	19	6.437	40.6	34.9	Low	-2.5517	0.0026	Decreasing	Medium
D-0259	12/7/2006	8/24/2020	14	9.858	15.269	11.2	Low	0.051	0.7011	Stable	Low
D-0547	12/16/2006	8/24/2020	14	13.645	18.7	15.735	Low	-0.0052	0.9128	Stable	Low
D-0673	12/7/2006	9/22/2020	13	18.8	25.68	21.282	Low	0.3202	0.0028	Increasing	Low
D-1236	12/7/2006	8/24/2020	14	18.4	24.44	21.02	Low	0.1819	0.0086	Increasing	Low
D-1292	12/11/2006	9/16/2020	13	4.33	8.98	5.318	Low	0.0851	0.2215	Stable	Low
D-1301	12/11/2006	7/27/2020	14	8.892	13.7	10.785	Low	-0.0799	0.4434	Stable	Low
D-1307	12/7/2006	9/22/2020	13	18.17	23.96	19.74	Low	0.1076	0.087	Stable	Low
D-1309	12/7/2006	9/21/2020	13	17.1	22.92	17.95	Low	0.1323	0.0041	Increasing	Low
D-1350	3/1/2006	7/28/2020	17	15.6	18.96	16.728	Low	0.0953	0.0168	Increasing	Low
D-1383	5/15/2006	8/25/2020	28	47.5	1,615	59.64	Low	1.4154	0.0505	Stable	Medium
D-1394	7/22/2006	9/16/2020	24	8.001	13.83	9.63	Low	0.1316	0.0161	Increasing	Low
D-1413	12/12/2006	7/27/2020	14	16.7	21.82	18.07	Low	0.1626	0.0285	Increasing	Low
D-1499	5/5/2010	8/24/2020	18	12.395	17.84	13.95	Low	0.0995	0.0686	Stable	Low
D-1503	6/29/2011	8/12/2020	13	22.06	26.39	23.78	Insufficient Data				

Table D12a: Chloride trend and status for Flagler County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
F-0064	2/14/2006	6/17/2020	28	12.237	1,500	1,195.435	High	-7.4302	0.0379	Decreasing	High
F-0176	5/25/2006	6/17/2020	32	494.06	970	635	High	-4.1367	0.168	Stable	High
F-0179	5/26/2006	6/16/2020	31	3,472	6,561.57	5,802.05	High	8.7112	0.6219	Stable	High
F-0200	5/25/2006	6/8/2020	15	1,790	2210	1,999.79	High	6.0862	0.5195	Stable	High
F-0208	8/17/2009	6/15/2020	20	26.9	477.75	297.967	High	24.4322	0.0005	Increasing	High
F-0209	4/9/2008	6/17/2020	18	539	1,060	987.49	High	-10.8955	0.0089	Decreasing	High
F-0251	1/21/2006	6/16/2020	22	32	39.28	35.52	Low	0.2687	0.0482	Increasing	Low
F-0294	1/21/2006	6/15/2020	21	101.68	523	492	High	-2.2049	0.139	Stable	Medium
F-0353	1/21/2006	6/15/2020	21	0	628.27	606	High	1.6193	0.0967	Stable	Medium
F-0384	7/31/2008	6/16/2020	22	496	1100	982.5	High	0	1	Stable	Low
F-0395	2/19/2014	6/15/2020	9	17.28	21.65	18.061	Insufficient Data				

Table D12b: TDS trend and status for Flagler County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
F-0064	2/14/2006	6/17/2020	29	2,315	3,140	2,560	High	-11.2528	0.3108	Stable	High
F-0176	5/25/2006	6/17/2020	33	1,190	1,990.5	1,425	High	-15.3975	0.0101	Decreasing	High
F-0179	5/26/2006	6/16/2020	31	9,880	12,900	10,500	High	-13.759	0.4856	Stable	High
F-0200	5/25/2006	6/8/2020	15	3,580	4,540	4,220	High	-3.4353	0.6556	Stable	High
F-0208	8/17/2009	6/15/2020	21	80	4,420	774	High	24.7724	0.0462	Increasing	High
F-0209	4/9/2008	6/17/2020	19	1,202	2,490	2,093	High	-23.3078	0.025	Decreasing	High
F-0251	1/21/2006	6/16/2020	23	440	488	466	Medium	0.397	0.6154	Stable	Low
F-0294	1/21/2006	6/15/2020	23	168	1,714	1,375	High	-14.2305	0.0859	Stable	High
F-0353	1/21/2006	6/15/2020	22	1,260	1,760	1,440	High	-4.0156	0.3665	Stable	High
F-0384	7/31/2008	6/16/2020	22	1,780	2,420	2,120	High	-21.0307	0.0753	Stable	High
F-0395	2/19/2014	6/15/2020	9	260	301	283	Insufficient Data				

Table D13a: Chloride trend and status for Nassau County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
N-0220	1/16/2006	9/21/2020	14	23.6	30.17	25.89	Low	0.212	0.0892	Stable	Low
N-0221	1/16/2006	9/23/2020	14	26.5	32.75	28.88	Low	0.1747	0.0995	Stable	Low
N-0237	1/17/2006	9/15/2020	12	17.9	21.15	19	Low	0.0959	0.2714	Stable	Low
N-0304	3/15/2007	8/12/2020	26	24.4	57.8	28.8	Low	0.1471	0.2702	Stable	Low
N-0311	11/12/2007	9/21/2020	19	21.2	28.53	24.1	Low	0.1259	0.2329	Stable	Low
N-0320	8/13/2007	9/22/2020	20	24.2	32.87	27.47	Low	0.1195	0.2169	Stable	Low
N-0334	12/17/2008	9/23/2020	16	23.99	28.75	25.47	Low	0.1332	0.1254	Stable	Low
N-0341	3/14/2014	9/21/2020	7	23.99	60.39	29.8	Insufficient Data				
N-0344	3/27/2014	8/25/2020	9	24.04	35.55	24.63	Insufficient Data				
N-0347	7/30/2015	8/25/2020	6	20.53	30.57	22.05	Insufficient Data				

Table D13b: TDS trend and status for Nassau County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
N-0220	1/16/2006	9/21/2020	13	373	460	401.111	Medium	1.981	0.2001	Stable	Medium
N-0221	1/16/2006	9/23/2020	13	430.5	508	452.778	Medium	0.2613	0.6693	Stable	Low
N-0237	1/17/2006	9/15/2020	14	263.333	1,452	297.5	Medium	-2.2436	0.2284	Stable	Medium
N-0304	3/15/2007	8/12/2020	25	441	728	482	Medium	-1.5806	0.0718	Stable	Medium
N-0311	11/12/2007	9/21/2020	18	282	413	349.5	Medium	0.88	0.5439	Stable	Low
N-0320	8/13/2007	9/22/2020	19	394	520	449	Medium	-1.215	0.3809	Stable	Medium
N-0334	12/17/2008	9/23/2020	15	364	423	387.5	Medium	0.841	0.4285	Stable	Low
N-0341	3/14/2014	9/21/2020	7	384.5	450	397	Insufficient Data				
N-0344	3/27/2014	8/25/2020	9	390	476	421.667	Insufficient Data				
N-0347	9/21/2016	8/25/2020	5	311.111	346	320.556	Insufficient Data				

Table D14a: Chloride trend and status for Putnam County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
P-0123	9/24/2006	7/13/2020	14	34.8	47.39	39.98	Low	0.6412	0.0118	Increasing	Low
P-0132	3/28/2006	7/14/2020	24	3.99	9.6	4.89	Low	0.0324	0.2974	Stable	Low
P-0166	3/28/2006	7/14/2020	17	4.04	8.61	4.9	Low	0.0533	0.1275	Stable	Low
P-0172	3/28/2006	6/3/2020	23	388.19	828.45	722.71	High	4.7902	0.1538	Stable	High
P-0246	9/25/2006	6/3/2020	14	7.56	11.38	8.35	Low	0.0811	0.0693	Stable	Low
P-0270	6/23/2006	7/21/2020	22	7.74	13.15	9.32	Low	0.1354	0.0588	Stable	Low
P-0408	9/25/2006	7/21/2020	15	5.2	19.45	8.9	Low	1.0483	0.0047	Increasing	Medium
P-0410	2/18/2007	7/21/2020	14	0.25	27.68	25.15	Low	0.008	0.8694	Stable	Low
P-0450	1/10/2006	7/14/2020	23	139	166.38	159.33	Medium	0.5812	0.0096	Increasing	Low
P-0469	2/18/2007	7/21/2020	14	4.36	77.2	57.37	Low	-2.0771	0.0487	Decreasing	Medium
P-0472	9/27/2006	7/14/2020	14	618.9	732	686.3	High	-2.6838	0.1889	Stable	Medium
P-0510	9/24/2006	7/13/2020	14	4.55	9.46	5.62	Low	0.0087	0.8267	Stable	Low
P-0736	6/23/2006	7/21/2020	23	42.18	86.3	58.8	Medium	-0.4898	0.1256	Stable	Low
P-0772	9/24/2006	7/13/2020	14	6.5	12.31	8.5	Low	0.0742	0.2284	Stable	Low
P-0817	9/25/2006	6/3/2020	14	8.14	10.33	9	Low	0.1179	0.0325	Increasing	Low
P-0891	1/10/2006	7/13/2020	24	157	185	170	Medium	0.048	0.7279	Stable	Low
P-2037	2/18/2007	6/16/2020	13	22.65	26.75	23.5	Low	0.2307	0.0072	Increasing	Low
P-4043	1/10/2006	7/21/2020	24	10.24	360	331.5	High	-0.3749	0.5346	Stable	Low
P-4083	4/3/2007	7/15/2020	13	4.72	10.3	5.34	Low	0.0588	0.2997	Stable	Low
P-4086	4/3/2007	7/13/2020	13	5.1	10.11	5.85	Low	-0.0535	0.3601	Stable	Low

Table D14b: TDS trend and status for Putnam County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
P-0123	9/24/2006	7/13/2020	14	210	378	232	Low	1.9078	0.0246	Increasing	Medium
P-0132	3/28/2006	7/14/2020	23	77	305	104	Low	-0.0968	0.8948	Stable	Low
P-0166	3/28/2006	7/14/2020	16	68.5	134	112	Low	2.2285	0.0382	Increasing	Medium
P-0172	3/28/2006	6/3/2020	24	1,580	1,998	1,730	High	2.0417	0.5681	Stable	Medium
P-0246	9/25/2006	6/3/2020	15	110	151	139	Low	0.0341	1	Stable	Low
P-0270	2/18/2007	7/21/2020	21	160	209	177.5	Low	0.5508	0.3976	Stable	Low
P-0408	9/25/2006	7/21/2020	14	62	143.889	102.25	Low	3.2822	0.0052	Increasing	High
P-0410	2/18/2007	7/21/2020	14	263	316	281.75	Medium	-0.0942	1	Stable	Low
P-0450	1/10/2006	7/14/2020	23	0	420	365	Medium	1.4291	0.5262	Stable	Medium
P-0469	2/18/2007	7/21/2020	14	109	434	381.5	Medium	-7.1244	0.0798	Stable	High
P-0472	9/27/2006	7/14/2020	13	1,349	1,620	1,510	High	-7.075	0.1984	Stable	High
P-0510	9/24/2006	7/13/2020	14	37.3	170	137.5	Low	2.1405	0.1889	Stable	Medium
P-0736	2/18/2007	7/21/2020	22	232	322	302.5	Medium	-2.8506	0.0013	Decreasing	Medium
P-0772	9/24/2006	7/13/2020	14	120	200	142.5	Low	1.8811	0.0325	Increasing	Medium
P-0817	9/25/2006	6/3/2020	15	81.3	109	92	Low	0.5007	0.6198	Stable	Low
P-0891	1/10/2006	7/13/2020	23	433	671	471	Medium	1.7755	0.3977	Stable	Medium
P-2037	2/18/2007	6/16/2020	14	135	165	155	Low	1.0799	0.0619	Stable	Medium
P-4043	1/10/2006	7/21/2020	23	698.5	1,120	817	High	-2.2974	0.4128	Stable	Medium
P-4083	4/3/2007	7/15/2020	13	97	138	115	Low	0.8574	0.2712	Stable	Low
P-4086	4/3/2007	7/13/2020	12	89.3	151	116.5	Low	2.8384	0.0112	Increasing	Medium

Table D15a: Chloride trend and status for St Johns County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
SJ0027	2/22/2006	7/27/2020	23	170.72	280.435	206	Medium	0.2631	0.7713	Stable	Low
SJ0320	1/19/2006	6/3/2020	25	148.03	183.926	160	Medium	-0.1722	0.726	Stable	Low
SJ0323	6/30/2009	6/10/2020	16	58	69.8	61.25	Medium	0.5592	0.0131	Increasing	Low
SJ0324	1/12/2006	7/27/2020	23	15.4	19.92	16.7	Low	0.1324	0.0043	Increasing	Low
SJ0331	4/21/2006	6/10/2020	26	12.88	457	420	High	-0.5856	0.659	Stable	Low
SJ0333	1/19/2006	6/8/2020	15	2,290	3,034.95	2710	High	20.8017	0.0748	Stable	High
SJ0355	7/11/2007	7/29/2020	25	14.87	23.1	18.44	Low	0.1345	0.0043	Increasing	Low
SJ0408	2/27/2012	6/3/2020	11	84.02	1,022.7	644	Insufficient Data				
SJ0508	6/18/2006	7/27/2020	22	4.96	10.4	5.88	Low	0.1302	0.0178	Increasing	Low
SJ0516	4/21/2006	6/8/2020	15	654.83	2,222	1,620.23	High	-21.1806	0.235	Stable	High
SJ0602	4/28/2006	6/8/2020	21	529	716.33	621	High	2.2966	0.319	Stable	Medium
SJ0824	6/17/2006	6/9/2020	22	51.58	4,47.513	412.7	High	1.9687	0.055	Stable	Medium
SJ2556	6/18/2006	7/28/2020	20	19.5	25.5	22.29	Low	0.2447	0.0058	Increasing	Low
SJ2574	7/12/2006	7/29/2020	21	109	124.49	118.67	Medium	0.4807	0.1014	Stable	Low

Table D15b: TDS trend and status for St Johns County Monitoring wells (UFA) – SJRWMD

	POR		Statistics					Mann-Kendall test results			
Station	**Start**	**End**	**No of obs.**	**Min (mg/L)**	**Max (mg/L)**	**Median (Mg/L)**	**Status**	**Slope (mg/L/yr)**	**P-value**	**Trend**	**Rate of change**
SJ0027	2/22/2006	7/27/2020	25	1,500	1,925	1,561	High	1.9048	0.4262	Stable	Medium
SJ0320	1/19/2006	6/3/2020	26	1,606	1,915	1,690	High	0.8267	0.6913	Stable	Low
SJ0324	1/12/2006	7/27/2020	24	413	793	691.61	High	3.0624	0.0105	Increasing	High
SJ0333	1/19/2006	6/8/2020	15	5,310	6,410	5,804	High	-9.9918	0.6198	Stable	Low
SJ0355	7/11/2007	7/29/2020	23	347	449	404	Medium	0.4101	0.7916	Stable	Low
SJ0408	8/16/2012	6/3/2020	12	150	2,494	2,085	Insufficient Data				
SJ0508	6/18/2006	7/27/2020	22	95	593	123	Low	0.4493	0.6516	Stable	Low
SJ0516	4/21/2006	6/8/2020	15	3,532	4,828	3,796	High	-16.9295	0.1376	Stable	High
SJ0602	4/28/2006	6/8/2020	24	1,551	2,136	1,838.5	High	-0.5769	0.862	Stable	Low
SJ2556	6/18/2006	7/28/2020	22	464	572	491	Medium	-0.4402	0.5728	Stable	Low
SJ2574	7/12/2006	7/29/2020	24	137	674	600.25	High	-0.7698	0.5849	Stable	Low

SJRWMD CUP Production Well Water Quality Assessment

Overview

Chloride and total dissolved solids (TDS) are useful chemical indicators of groundwater quality (GWQ) degradation due to saltwater intrusion. Chloride is used as the “tracer” for saltwater intrusion because it is one of the principal chemical constituents in seawater and is unaffected by ion exchange (as is sodium, the other principal component). TDS is an additional chemical constituent that reflects overall changes in groundwater quality. Trends in chloride and TDS concentrations were quantified and interpreted based upon the results of nonparametric and multivariate statistical tests described in the following section.

Since statistically significant trends in chloride concentration can be an indicator of groundwater degradation due to saltwater intrusion, this evaluation focuses on chloride and TDS time series data. In the 2017 NFRWSP, 17 SJRWMD CUP production wells either exceeded the SDWS prior to 2015 (6 wells) or were projected to exceed the SDWS by 2035 (11 wells). The analysis completed for this plan focused on these 17 CUP wells (Figure D10 and Table D16).

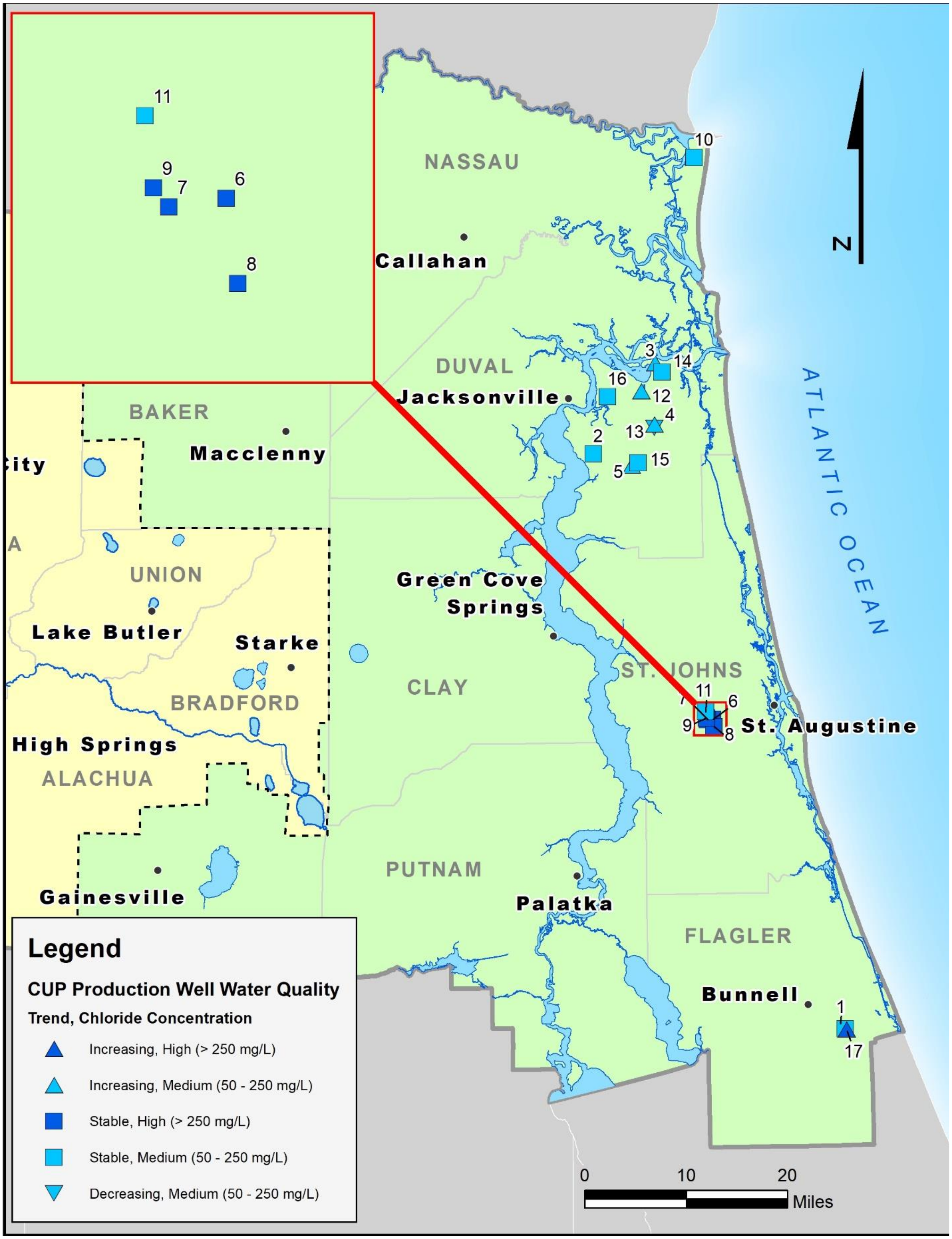

Figure D10. CUP Production Well Water Quality Assessment – Status and Trends Well Index

Table D16. CUP Production Well Water Quality Assessment – Status and Trends Well Index

Map Index Number	Station ID	Station Alias	Site Name	Trend	Chloride Concentration Group	Chloride Concentration (mg/L)
1	34525	10	City of Flagler Beach	Stable	Medium	100
2	22525	Brierwood - 4	Brierwood	Stable	Medium	50
3	6034	Beacon Hills 2	Beacon Hills	Increasing	Medium	130
4	6063	Oakridge - 5304	Oakridge	Decreasing	Medium	130
5	6097	Deerwood 3 - 5701	Deerwood 3	Increasing	Medium	95
6	34240	TR-43	Tillman Ridge Wellfield	Stable	High	368
7	34242	TR-45	Tillman Ridge Wellfield	Stable	High	346
8	14780	TR-42	Tillman Ridge Wellfield	Stable	High	271
9	34243	TR-46	Tillman Ridge Wellfield	Stable	High	290
10	11380	9	Fernandina Beach Mill	Stable	Medium	65
11	38399	TR-48	Tillman Ridge Wellfield	Stable	Medium	256
12	5894	Monument 2	Monument Rd	Increasing	Medium	212
13	6060	Oakridge - 5301	Oakridge	Increasing	Medium	90
14	6212	13 ARLINGTON (Well 3)	Hidden Hills	Stable	Medium	100
15	22540	Deerwood 3 - 5706	Deerwood 3	Stable	Medium	68
16	6087	Arlington - 5404	Arlington Wellfield	Stable	Medium	193
17	34526	11	City of Flagler Beach	Increasing	High	310

Methodology

Groundwater samples collected at the 17 CUP production wells in support of CUP groundwater quality monitoring requirements were submitted for laboratory chemical analyses of selected or all major ions (calcium, magnesium, potassium, sodium, bicarbonate, chloride, and sulfate). Sampling frequencies varied from quarterly to semi-annual and annual schedules. Trends in time series chloride and TDS concentration data were quantified and interpreted based upon the results of nonparametric statistical tests described in the following section. The subsections that follow present the methodology and analysis of the Mann-Kendall trend test used to investigate the current status (concentration) and trend (rate of change of concentration) of groundwater sampled from these wells.

Chloride and TDS water quality data was downloaded from the SJRWMD database and subsequently post-processed in Excel to create a format readable in the Python programming environment. Chloride and TDS water quality data collected for 10 years, or more were used in a Mann-Kendall statistical trend analysis (MKTA). One of the strengths of the MKTA is, it is a nonparametric statistical test that does not depend on the type of statistical distribution in the data (Mann 1945; Kendall 1975). It is also resistant to outliers and missing data. These qualities make the MKTA more suitable for the current data which has the possibility of harboring some missing data in the time series.

Test statistics generated by the MKTA include the Mann-Kendall correlation coefficient (τ), the median slope of the trend (in mg/L/yr), the z-value, and the p-value. The p-value is usually interpolated from statistical tables using the computed z-value. The two most important outputs of this analysis are the p-value (for identifying the significance of the trend) and the mean slope of the trend (for determining the rate at which the concentration status is changing). A trend is considered statistically significant if the p-value is less than a certain significance level (SL) value. Common SL values used in the literature are 0.1 (10%), 0.05 (5%), or 0.01 (1%) (Kamal and Pachauri, 2018). To be consistent with previous NFRWSP, a SL value of 0.05 (5%) was used in the current analysis. If the p-value of the test is lower than the SL, then there is statistically significant evidence that a trend is present in the time series data. The SL results were used to classify the results into stable, increasing, or decreasing.

A time series plot of chloride and TDS concentration, relative to the average rate of withdrawal (pumping) for each station, was visually interpreted to assess the presence of breaks over the entire period of record (POR) for a given production well. These breaks are inflection points in the time series where the slope of the trend changes direction or relative magnitude. A time series with no interpreted breakpoints was evaluated in the MKTA as a single segment over the entire POR. A time series with interpreted breakpoints was evaluated in the MKTA in a piecewise fashion over each segment of the entire data POR.

Figure D11 shows an example of a dataset series broken down into four segments. In this case, a separate MKTA was done for each segment. However, in a summary analysis, only the final segment was used to evaluate the current potential trend in the chloride or TDS concentration. Table D17 shows the segments with their associated sub-PORs for each segment. This segment-based method of analysis was applied only to the SJRWMD's 17 CUP production wells.

Water Quality Status

The water quality status of the 17 CUP production wells, with respect to both chloride and TDS concentration, was assessed by looking at their median recorded concentration values over the POR for each production well.

Using the median values and adopting criteria like that used in the previous NFRWSP, the status of the wells relative to chloride and TDS concentrations were defined respectively, as:

- Low rate: chloride > 50.0 mg/L and TDS < 250.0 mg/L
- Medium rate: 50.0 mg/L < chloride < 250.0 mg/L and 250.0 mg/L < TDS < 500.0 mg/L
- High rate: chloride > 250.0 mg/L/yr and TDS > 500.0 mg/L/yr

This relative classification was adopted to define the status of both CUP production and monitoring wells in this analysis.

Water Quality Trends

Using the pre-determined SL value of 0.05 (5%), the time series of data records of chloride or TDS data was input into the MKTA model. The p-value was used to determine whether there was a statistically significant trend to the data. If there was no statistically significant trend, then the water quality was considerable to be stable. If there was a statistically significant trend, then the calculated data slope was used to determine the direction and rate of the change as showing in the table. The orientation of the trend is indicated by a calculated median slope. A negative slope implies a decreasing trend in the data. A positive slope value means an increasing trend in data. The relative magnitude was assigned for statistically significant trends in chloride concentration to quantify the potential for saltwater intrusion:

- Low rate: *slope* < 1.0 mg/L/yr
- Medium rate: 3.0 mg/L/yr > *slope* > 1.0 mg/L/yr
- High rate: *slope* > 3.0 mg/L/yr

For the CUP production wells, the results of the of the MKTA are shown in Tables D18 and D19 for chloride and TDS, respectively. Each of these tables show a simple statistic of the raw data, followed by the output of the MKTA.

Table D20 presents the summary results of the analysis from the last segment of each time series data. This last segment is assumed to represent the current situation of the production well analyzed. While both TDS and chlorides were evaluated, the focus of this planning assessment is the chloride status and trend analysis Table D20b shows that only five of the 17 CUP production wells are showing an increasing trend in chloride. A summary of these wells is presented in Table D21a. Table D21b categorizes the wells with an increasing trend based on their relative chloride concentration status.

Table D17: SJRWMD CUP Production Wells - Segments for Chloride and TDS data used in trend analysis

				Segment's Period of Record (POR)							
CUP Number	**Station ID**	**No. of Segments**	**Analyte**	**1**		**2**		**3**		**4**	
1198	14780	4	CHLORIDE	2004.00	2006.75	2007.00	2010.50	2010.75	2017.75	2018.25	2021.75
			TDS	2004.00	2006.75	2007.00	2010.50	2010.50	2017.75	2018.25	2021.75
1198	34240	2	CHLORIDE	2005.00	2015.00	2015.75	2018.25	NA		NA	
			TDS	2005.00	2008.75	2009.00	2018.75				
1198	34242	4	CHLORIDE	2007.50	2009.25	2009.50	2010.75	2011.00	2014.25	2014.50	2021.75
			TDS	2007.50	2009.25	2009.50	2010.75	2011.00	2014.25	2014.50	2021.75
1198	34243	3	CHLORIDE	2007.50	2010.25	2010.50	2019.25	2019.50	2021.75	NA	
			TDS	2007.50	2010.25	2010.50	2019.25	2019.50	2021.75		
1198	38399	3	CHLORIDE	2009.50	2011.75	2012.50	2018.25	2019.00	2021.75	NA	
			TDS	2009.50	2011.75	2012.50	2018.25	2019.00	2021.75		
50077	11380	4	CHLORIDE	2006.25	2008.00	2008.25	2010.50	2010.75	2014.00	2014.25	2016.25
			TDS	2006.25	2008.00	2008.25	2010.75	2011.00	2014.00	2014.50	2016.25
59	34525	2	CHLORIDE	2009.25	2012.25	2018.00	2021.50	NA		NA	
			TDS	2009.25	2012.25	2018.00	2021.50				
59	34526	1	CHLORIDE	2009.00	2021.75	NA		NA		NA	
			TDS	2012.75	2021.75						
702	6212	2	CHLORIDE	2006.25	2015.25	2017.00	2019.00	NA		NA	
			TDS	2006.25	2015.25	2017.00	2019.00				
88271	22525	3	CHLORIDE	2000.25	2004.50	2006.25	2017.25	2018.25	2021.75	NA	
			TDS	2000.25	2004.50	2006.25	2017.25	2018.25	2021.75		
88271	22540	3	CHLORIDE	2000.00	2005.50	2006.00	2014.75	2017.50	2021.75	NA	
			TDS	2000.00	2005.50	2006.00	2014.75	2017.50	2021.75		
88271	5894	3	CHLORIDE	2004.50	2014.25	2014.50	2018.50	2018.75	2021.50	NA	
			TDS	2004.25	2014.25	2014.50	2018.50	2018.75	2021.50		
88271	6034	1	CHLORIDE	2004.50	2021.25	NA		NA		NA	
			TDS	2004.50	2021.25						
88271	6060	2	CHLORIDE	1998.00	2003.00	2004.00	2021.75	NA		NA	
			TDS	1998.00	2003.00	2004.00	2021.75				
88271	6063	2	CHLORIDE	1998.00	2015.00	2018.25	2021.75	NA		NA	
			TDS	1998.00	2015.00	2018.25	2021.75				
88271	6087	3	CHLORIDE	1998.00	2003.50	2004.25	2014.75	2015.25	2018.50	NA	
			TDS	1998.00	2003.00	2004.25	2014.75	2015.25	2018.50		
88271	6097	1	CHLORIDE	1998.00	2021.75	NA		NA		NA	
			TDS	1998.00	2021.75						

Table D18: MKTA Chloride Concentration Trend Results for Selected SJRWMD CUP Production wells

County	CUP #	CUP Name	Station	POR	Sample size	Min (mg/L)	Max (mg/L)	Median (mg/L)	Status	Segment	Tau (τ)	Slope (mg/L/yr.)	P-value	Trend
St Johns	1198	SJCUD Northwest & Tillman Ridge	14780	2004.00 2021.75	45	180	690	297.5	High	1	0.732	55.2	0.045	Increasing
										2	-0.385	-13.2	0.063	Stable
										3	0.57	2.13	<0.0001	Increasing
										4	-0.6	-3.51	0.221	Stable
St Johns	1198	SJCUD Northwest & Tillman Ridge	34240	2005.00 2018.25	49	267	470	372	High	1	0.757	4.629	<0.0001	Increasing
										2	-0.5	-10.933	0.108	Stable
St Johns	1198	SJCUD Northwest & Tillman Ridge	34242	2007.50 2021.75	51	250	654	382	High	1	0.619	11.667	0.072	Stable
										2	-0.8	-15.917	0.086	Stable
										3	0.308	8.607	0.161	Stable
										4	0.217	3.5	0.167	Stable
St Johns	1198	SJCUD Northwest & Tillman Ridge	34243	2007.50 2021.75	50	174	452	290	High	1	-0.455	-1.857	0.062	Stable
										2	0.732	7.103	<0.0001	Increasing
										3	-0.238	-6	0.548	Stable
St Johns	1198	SJCUD Northwest & Tillman Ridge	38399	2009.50 2021.75	39	200	314	279	High	1	0.074	0.2	0.9	Stable
										2	0.144	0.5	0.426	Stable
										3	0.022	0.733	1	Stable
Nassau	50077	RockTen	11380	2006.25 2016.25	38	34	94	47.5	Low	1	-0.733	-2.333	0.06	Stable
										2	0.556	1.333	0.048	Increasing
										3	0.923	1.655	<0.0001	Increasing
										4	-0.276	-2	0.566	Stable
Flagler	59	Flagler Beech	34525	2009.25 2021.50	25	28	340	100	Medium	1	0.753	3.829	<0.0001	Increasing
										2	-0.396	-0.396	0.146	Stable

County	CUP #	CUP Name	Station	POR	Sample size	Min (mg/L)	Max (mg/L)	Median (mg/L)	Status	Segment	Tau (τ)	Slope (mg/L/yr.)	P-value	Trend
Flagler	59	Flagler Beech	34526	2009.002021.75	46	31	760	310	High	1	0.816	10.851	<0.0001	Increasing
Duval	702	Hidden Hills	6212	2006.25 2019.00	21	58.7	160	110	Medium	1	0.585	1.2	0.004	Increasing
										2	-0.333	-6.333	0.734	Stable
Duval	88271	JEA	22525	2000.25 2021.75	56	14	206	49.11	Low	1	0.849	0.679	<0.0001	Increasing
										2	0.922	3.662	<0.0001	Increasing
										3	0.345	0.267	0.161	Stable
Duval	88271	JEA	22540	2000.00 2021.75	59	12.7	172.83	45.3	Low	1	0.055	0	0.877	Stable
										2	0.803	3.748	<0.0001	Increasing
										3	-0.056	-0.78	0.917	Stable
Duval	88271	JEA	5894	2004.50 2021.50	51	134.41	364	267.69	High	1	0.757	5.438	<0.0001	Increasing
										2	0.733	5.563	0.004	Increasing
										3	0.584	3	0.025	Increasing
Duval	88271	JEA	6034[a]	2004.50 2021.25	48	61.29	342	160.42	Medium	1	0.463	2.187	<0.0001	Increasing
Duval	88271	JEA	6060	1998.00 2021.75	62	14.1	429	108.22	Medium	1	-0.143	-4.286	0.508	Stable
										2	0.637	2.715	<0.0001	Increasing
Duval	88271	JEA	6063[a]	1998.00 2021.75	64	15.9	234.94	118.62	Medium	1	0.707	1.782	<0.0001	Increasing
										2	-0.654	-0.37	0.002	decreasing
Duval	88271	JEA	6087	1998.00 2021.75	61	35	233	191	Medium	1	0.478	1.742	0.006	Increasing
										2	0.419	0.986	0.001	Increasing
										3	0.067	0.5	0.857	Stable
Duval	88271	JEA	6097[a]	1998.00 2021.75	60	9.18	232	117.16	Medium	1	0.803	2.045	<0.0001	Increasing

[a] UFA and LFA, all other wells are UFA

Table D19: MKTA TDS Concentration Trend Results for Selected SJRWMD CUP production wells

County	CUP #	CUP Name	Station	POR	Sample size	Min (mg/L)	Max (mg/L)	Median (mg/L)	Status	Segment	Tau (τ)	Slope (mg/L/yr.)	P-value	Trend
St Johns	1198	SJCUD Northwest & Tillman Ridge	14780	2004.00 2021.75	52	823	2,250	1,065	High	1	0.514	13	0.158	Stable
										2	-0.42	-26	0.042	Decreasing
										3	0.578	6.118	<0.0001	Increasing
										4	-0.6	0.038	1	Stable
St Johns	1198	SJCUD Northwest & Tillman Ridge	34240	2005.00 2018.25	49	932	1,500	1,150	High	1	0.605	16.769	0.002	Increasing
										2	0.393	3.333	0.002	Increasing
St Johns	1198	SJCUD Northwest & Tillman Ridge	34242	2007.50 2021.75	51	804	1,870	1,200	High	1	0.619	40	0.072	Stable
										2	-0.4	-20	0.462	Stable
										3	0.051	8.75	0.855	Stable
										4	0.228	10	0.149	Stable
St Johns	1198	SJCUD Northwest & Tillman Ridge	34243	2007.50 2021.75	50	776	1,460	1,000	High	1	-0.345	-7.2	0.161	Stable
										2	0.736	14.205	<0.0001	Increasing
										3	-0.429	-23.857	0.23	Stable
St Johns	1198	SJCUD Northwest & Tillman Ridge	38399	2009.50 2021.75	39	470	1,250	968	High	1	-0.429	-7.964	0.174	Stable
										2	0.362	6.1	0.041	Increasing
										3	-0.225	-5.556	0.419	Stable
Nassau	50077	RockTen	11380	2006.25 2016.25	38	470	730	527	High	1	-0.788	-10	0.051	Stable
										2	0.549	7.375	0.041	Increasing
										3	0.646	4.586	0.005	Increasing
										4	0.276	5	0.566	Stable
Flagler	59	Flagler Beech	34525	2009.25 2021.50	25	410	1,200	590	High	1	0.641	10	0.003	Increasing
										2	0.045	2	0.928	Stable
Flagler	59	Flagler beech	34526	2012.75 2021.75	35	610	1,600	1,100	High	1	0.51	19.259	<0.0001	Increasing
Duval	702		6212		21	320	580	512	High	1	0.332	1.667	0.1	Increasing

County	CUP #	CUP Name	Station	POR	Sample size	Min (mg/L)	Max (mg/L)	Median (mg/L)	Status	Segment	Tau (τ)	Slope (mg/L/yr.)	P-value	Trend
		Hidden Hills		2006.25 2019.00						2	-0.333	-24.583	0.734	Stable
Duval	88271	JEA	22525	2000.25 2021.75	56	370	870	526	High	1	-0.078	-0.496	0.782	Stable
										2	0.809	10.235	<0.0001	Increasing
										3	-0.127	-0.5	0.64	Stable
Duval	88271	JEA	22540	2000.00 2021.75	59	350	676	470	Medium	1	0.032	0	0.944	Stable
										2	0.77	6.333	<0.0001	Increasing
										3	-0.343	-6	0.246	Stable
Duval	88271	JEA	5894	2004.50 2021.50	51	201	1,003	823	High	1	0.714	8.396	<0.0001	Increasing
										2	0.422	6.5	0.107	Stable
										3	0.778	12.5	0.002	Increasing
Duval	88271	JEA	6034[a]	2004.50 2021.25	48	439	976	629	High	1	0.459	4.06	<0.0001	Increasing
Duval	88271	JEA	6060	1998.00 2021.75	62	188	1,200	549.5	High	1	-0.143	-9.286	0.511	Stable
										2	0.525	3.692	<0.0001	Increasing
Duval	88271	JEA	6063[a]	1998.00 2021.75	64	305	737	552	High	1	0.62	1.782	<0.0001	Increasing
										2	-0.423	-0.37	0.05	Stable
Duval	88271	JEA	6087	1998.00 2021.75	61	65	850	664	High	1	0.228	5.063	0.214	Stable
										2	0.419	3.05	0.001	Increasing
										3	0.556	9.455	0.032	Increasing
Duval	88271	JEA	6097[a]	1998.00 2021.75	60	200	891	650	High	1	0.695	4.224	<0.0001	Increasing

[a] UFA and LFA, all other wells are UFA

Table D20: Summary Trend of CUP production wells based on the Final Segment of the data series

						Chloride			TDS		
County	**CUP #**	**CUP Name**	**Station ID**	**Aquifer**	**Segment #**	**Slope (mg/L/yr.)**	**P-value**	**Trend**	**Slope (mg/L/yr.)**	**P-value**	**Trend**
St Johns	1198	Tillman	14780	UFA	4	-3.150	0.221	Stable	0.038	1.000	Stable
St Johns	1198	Tillman	34240	UFA	2	-10.933	0.108	Stable	3.333	0.002	Increasing
St Johns	1198	Tillman	34242	UFA	4	3.500	0.167	Stable	10.000	0.149	Stable
St Johns	1198	Tillman	34243	UFA	3	-6.000	0.548	Stable	-23.857	0.230	Stable
St Johns	1198	Tillman	38399	UFA	3	0.733	1.000	Stable	-5.556	0.419	Stable
Nassau	50077	RockTen	11380	UFA	4	-2.000	0.566	Stable	5.000	0.566	Stable
Flagler	59	Flg Beech	34525	UFA	2	-0.396	0.146	Stable	2.000	0.928	Stable
Flagler	59	Flg Beech	34526	UFA	1	0.816	<0.0001	Increasing	0.510	<0.0001	Increasing
Duval	702	Hidden Hi	6212	UFA	2	-6.333	0.734	Stable	-24.583	0.734	Stable
Duval	88271	JEA	22525	UFA	3	0.267	0.161	Stable	-0.500	0.640	Stable
Duval	88271	JEA	22540	UFA	3	-0.780	0.917	Stable	-6.000	0.246	Stable
Duval	88271	JEA	5894	UFA, LFA	3	3.000	0.025	Increasing	12.500	0.002	Increasing
Duval	88271	JEA	6034	UFA	1	2.187	<0.0001	Increasing	4.060	<0.0001	Increasing
Duval	88271	JEA	6060	UFA	2	2.715	<0.0001	Increasing	3.692	<0.0001	Increasing
Duval	88271	JEA	6063	UFA, LFA	2	-0.370	0.002	Decreasing	-0.370	0.050	Stable
Duval	88271	JEA	6087	UFA	3	0.500	0.857	Stable	9.455	0.032	Increasing
Duval	88271	JEA	6097	UFA, LFA	1	2.045	<0.0001	Increasing	4.224	<0.0001	Increasing

Table D21a: CUP production wells with increasing chloride trends

County	CUP Number	Station	Median conc (mg/L)	Slope (mg/L/year)	Trend	Status	Rate of change
Duval	88271	5894	267.69	3.000	Increasing	High	High
Duval	88271	6034	160.42	2.187	Increasing	Medium	Medium
Duval	88271	6060	108.22	2.715	Increasing	Medium	Medium
Duval	88271	6097	117.16	2.045	Increasing	Medium	Medium
Flagler	59	24526	310.0	0.816	Increasing	High	Low

Table 21b: Summary of CUP production wells with increasing chloride trends – Chloride Concentration Status and Rate of Change

Chloride Trend Category	Wells that Currently Exceed 50 mg/L but are <250 mg/l		Wells that Currently Exceed 250 mg/L	
	Number	County	Number	County
High rate of change (slope > 3.0 mg/L/yr)	N/A	N/A	1	Duval
Medium rate of change (3.0 mg/L > *slope* > 1.0 mg/L/yr)	3	Duval	N/A	N/A
Low rate of change (slope < 1.0 mg/L/yr)	N/A	N/A	1	Flagler

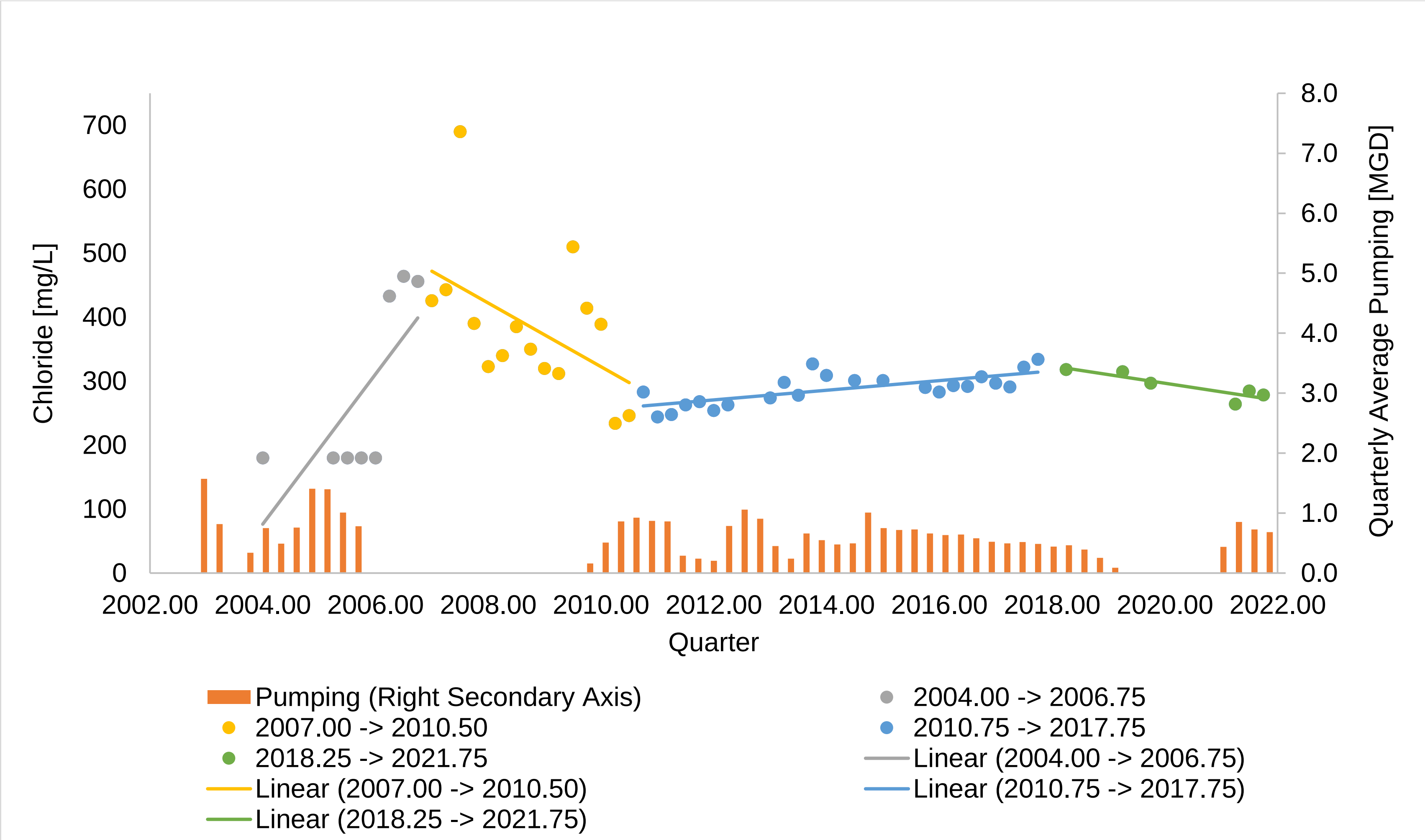

Figure D11. Example chloride time series graph showing four time segments

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