Appendix D

Evaluation of the Potential for Groundwater Quality Degradation Due to Saline Water Intrusion

Technical Memorandum
Joint North Florida Regional Water Supply Plan
Evaluation of the Potential for Groundwater Quality Degradation Due to Saline Water Intrusion
August 24, 2016

Executive Summary

The purpose of this evaluation was to identify wells within the North Florida Regional Water Supply Plan (NFRWSP) area where degradation of groundwater quality (GWQ) due to saline water intrusion (SWI) has been observed. The NFRWSP area encompasses 14 counties under the jurisdiction of the St. Johns River and Suwannee River Water Management Districts (SJRWMD and SRWMD, respectively). Groundwater quality degradation due to SWI is a consideration for the NFRWSP because degrading water quality can affect productivity of existing infrastructure, resulting in increased treatment cost, backplugging, well inactivation and replacement and moving withdrawal points. Although GWQ degradation poses a challenge for all affected water users, the issue is particularly acute for smaller utilities and water users that may have fewer options for infrastructure modifications.

There are approximately 2,370 permitted, active water supply wells within the SJRWMD portion of the NFRWSP area, and 406 of these wells are monitored for GWQ as a conditional requirement of a consumptive use permit (CUP). The 75 CUPs with GWQ monitoring requirements represent a cross-section of different uses including agriculture irrigation (6), aquaculture (1), commercial/industrial (11), golf course irrigation (10), household (2), landscape irrigation (3), nursery irrigation (1), power generation (2), public supply (35), and recreational (4). Suwannee River Water Management District monitors GWQ in an observation well network (OWN) consisting of 23 monitoring wells distributed throughout six counties. Collectively, these 429 wells (Figure D1) monitor GWQ in the Surficial Aquifer System (SAS) and Floridan Aquifer System (FAS).

Statistically significant trends in groundwater chloride concentration were identified at 133 wells, of which 92 were increasing (degrading) and 41 decreasing (improving). Thirty-three wells exhibiting degradation had calculated chloride increases of greater than 3 milligrams per liter per year (mg/L/yr; Table D4) and 35 wells had calculated increases at rates between 1 and 3 mg/L/yr (Figure D2; Table D5). In addition, 24 wells had calculated increases at rates of less than 1 mg/L/yr (Table D6), so while statistically calculated as a trend, the magnitude of the trend is relatively insignificant. It is important to note that although wells may exhibit a statistically significant decrease in water quality, the majority of these wells have low chloride and/or Total Dissolved Solids (TDS) concentrations indicative of fresh groundwater.

In order to understand the meaning of these trends, consideration of the actual chloride concentration in relation to the Florida Department of Environmental Protection (FDEP) Secondary Drinking Water Standard (SDWS) of 250 milligrams per liter (mg/L) for chloride is a key consideration. Among the 68 wells that exhibited a higher rate of chloride increase (greater than 1 mg/L/yr), the SDWS was exceeded prior to the year 2015 at only six wells

and was projected to be exceeded by 2035 at only 11 additional wells (Table D1; Figure D3). Thus, of these 68 wells, 75% (51 wells) were projected to remain below the SDWS throughout the planning period.

Table D1: Analyzed Wells with Trends in Chloride Concentration Projected to Exceed 250 mg/L by 2035

Chloride Trend Category	Wells that Currently Exceed 125 mg/L		Wells that Currently Exceed 250 mg/L		Additional Wells Projected to Exceed 250 mg/L by 2035	
	Number	County	Number	County	Number	County
High Rate of Change (33 wells)	9	Duval, Flagler, St. Johns	5	St. Johns	11	Duval, Flagler, Nassau, St. Johns
Medium Rate of Change (35 wells)	1	Duval	0	—	1	Duval
Low Rate of Change (24 wells)	0					

Statistically significant trends in TDS and groundwater geochemistry were consistent with the results of the chloride trend analyses. The FDEP SDWS of 500 mg/L for TDS was exceeded prior to 2015 at 20 wells and was projected to be exceeded by 2035 at four additional wells. The groundwater geochemistry was transitioning from characteristics of fresh water to saline water at 18 wells.

Some wells exhibiting patterns of GWQ degradation could not be quantified as statistically significant due to an inadequate period of record (POR), inconsistent sampling and/or ambiguous or limited laboratory chemical analytical results. The number of wells exhibiting GWQ degradation due to SWI may increase or decrease from the numbers reported in this evaluation as additional time series chemical data are collected, thereby improving test statistics. Additionally, the rate of degradation due to SWI in groundwater has been reduced at some water supply wells through backplugging of deeper zones containing more mineralized groundwater. The 68 wells with a higher rate of chloride increase occurred within four counties (Duval, Flagler, Nassau, and St Johns) in the SJRWMD portion of the NFRWSP area and are generally clustered along the St. Johns River and the Atlantic coastline (Figure D2). Sixty-five of these wells were FAS water supply wells and three were SAS water supply wells.

When viewed in total, the primary conclusion of this analysis is that GWQ may only constrain the availability of fresh groundwater in a relatively limited geographic area within the NFRWSP area – portions of Duval, Flagler, Nassau, and St. Johns counties – east of the St. Johns River. Based on the groundwater chemistry analyses performed as part of this study, the changes in these wells are primarily caused by localized upconing and not

wide-scale lateral movement of seawater. Saltwater intrusion from upconing is likely a response to withdrawals of groundwater from the water supply well and/or combined withdrawals of groundwater from the wellfield. The SJRWMD is working directly with the users of the affected wells to reduce these trends through a variety of techniques such as well backplugging and individual well pumping restrictions.

Introduction

Chloride, TDS and groundwater geochemistry are useful chemical indicators of GWQ degradation due to SWI. Chloride was used as the "tracer" for SWI 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 and groundwater geochemistry encompass a suite of additional chemical constituents that reflect overall changes in GWQ. Trends in time series chemical data for these indicators were quantified and interpreted based upon the results of nonparametric and multivariate statistical tests described in the following section.

Groundwater samples collected at permitted wells in support of GWQ 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 biannual and annual schedules. At some wells, GWQ has been monitored for several decades over the POR.

Of the 429 wells evaluated, 54 were completed into the SAS (all in Flagler County) and 375 into the FAS. Of the 375 FAS water supply wells, 255 were completed into the upper Floridan aquifer (UFA) and 114 were multi-zone completed into the UFA and the lower Floridan aquifer (LFA). Construction information was not available for six FAS water supply wells to identify the hydrogeologic zone(s).

Unlike monitoring wells that characterize GWQ over a discrete hydrogeologic interval, water supply wells produce a blend of GWQ from multiple flow zones throughout the vertical column in the FAS. If a FAS water supply well exhibits degradation, then it is intuitive that the chemical indicators in the hydrologic zone(s) responsible for the salinity are increasing at rates greater than measured in the "blended" water produced from the water supply well.

Method

A common deterministic component in a time series is a trend, which is the tendency for successive values to increase or decrease over time. Trends in chloride concentration were quantified and interpreted using nonparametric Mann-Kendall regression (MKR) and Sen's test statistical methods. Nonparametric statistical tests do not depend on distributional assumptions regarding data and are resistant to outliers, missing data and non-detects. Test statistics generated using these methods included median slope of the trend in mg/L/yr, Kendall's correlation coefficient (τ), 2-tailed probability value ($\alpha/2$) and significance level (SL). The 95% SL was used to identify groundwater with statistically significant trends in chloride concentration.

A time series plot of chloride concentration and Mann-Kendall regression (MKR) relative to the average rate of withdrawal (based upon available data) for each station was visually

interpreted to assess the presence of break points over the POR. Break points are inflection points in a time series where the slope of the trend changes sign (for example, from increasing to decreasing) or relative magnitude (for example, from gentle to steep). A time series with no interpreted break points was evaluated as a single segment over the entire POR (Figure D4); and a time series with an interpreted break point(s) was evaluated in piecewise segments (Figure D5). The most recent segment of a piecewise solution was used to evaluate a potential trend in chloride concentration.

A relative trend magnitude was assigned for statistically significant trends in chloride concentration ≥ 95% SL to quantify the potential for SWI or continued SWI:

≥ +3.0 mg/L/yr – high rate

< +3.0 mg/L/yr, ≥ +1.0 mg/L/yr – medium rate

< +1.0 mg/L/yr, > 0 mg/L/yr – low rate

< 0 mg/L/yr – freshening

A linear equation derived for the MKR was projected forward 20 years into the future (2035) to estimate the year that the chloride concentration might equal or exceed 250 mg/L for trends in chloride concentration ≥ 95% SL in the high and medium trend rates. Assuming anthropogenic and meteorological stressors influencing hydrologic conditions remain relatively unchanged, a chloride concentration increasing at a rate of 5 mg/L/yr would project to increase by 100 mg/L in 20 years. The chloride concentration for the lowest increasing trend magnitude and decreasing trends were not projected forward because chloride concentrations were generally low and the estimated rates of change were very small or decreasing (becoming more like fresh water).

Trends in TDS concentration were quantified using MKR and Sen's test statistical methods for wells with trends in chloride concentration ≥ 95% SL at the high and medium trend rates, with an additional constraint that the medium trend rate included only wells with predicted chloride concentrations projected to exceed 250 mg/L through the year 2035. Total Dissolved Solids concentrations were projected forward 20 years into the future for wells with statistically significant (≥ 95% SL) trends to predict the year that TDS concentrations would equal or exceed 500 mg/L.

Trends in groundwater geochemistry were quantified and visually interpreted using Piper-trilinear diagrams for all wells with increasing trends in chloride concentration ≥ 95% SL. Time series major ion chemical data used for groundwater geochemical trend analyses were selected at random intervals for sampling events coincident with chloride concentrations plotting on or near the chloride MKR. Preference was given to sampling events with major ion data passing quality assurance test balances ≤ 5% difference (but not > 10% difference unless due to limited data).

Groundwater geochemistry was quantified based upon the relative percentages of equivalent concentration for the four major cations (calcium, magnesium, potassium, and sodium) and the three major anions (bicarbonate, chloride and sulfate). Groundwater with a dominant ion pair has a cation and an anion present in equivalent concentrations ≥ 50% (for example, calcium–bicarbonate and sodium chloride). Groundwater without a dominant (< 50%) ion pair has a mixture of cations and/or anions (for example, calcium–

bicarbonate/chloride and calcium/sodium–chloride). Trilinear diagrams were used to graphically represent equivalent concentration for the major cations and anions relative to each other on different axes in separate triangular grids, and define the groundwater geochemistry (Figures D6a and D6b).

Piper diagrams were used to graphically represent percentages of equivalent concentration for major ion pairs relative to parallel axes that increase in opposite directions in a four-sided rectilinear (diamond) grid. Frazee (1982) represented geochemical boundaries for various UFA source groundwater on a Piper diagram to graphically illustrate patterns for major ion pairs indicative of degradation due to SWI. Groundwater with dominant major ion pairs such as calcium-bicarbonate and calcium-sulfate that are generally indicative of fresh water, plot on the left region of the Piper in fields classified as Fresh Recharge Water (FRW) and Formation Water (FW); a sodium-chloride geochemical type of groundwater indicative of saline water, plots on the right region in fields classified as Connate Water (CW) and sea water (SW); mixtures exhibiting geochemical characteristics of fresh and saline water plot in the central regions in fields classified as Transitional Water (TW) and Transitional Connate Water (TCW).

Results

Time series chemical data for 429 wells were evaluated for trends in chloride concentration, TDS concentration and geochemistry. Four hundred six (406) of these wells are monitored for GWQ as a conditional requirement of the CUP issued by SJRWMD. Suwannee River Water Management District monitors GWQ in an OWN consisting of 23 monitoring wells distributed throughout six counties.

Statistically significant trends in chloride concentration were identified in groundwater at 133 wells of which 92 were increasing (degrading) and 41 decreasing (improving). Thirty-three wells exhibiting degradation had calculated SWI increases of greater than 3 mg/L/yr (Table D4); 35 wells had calculated increases at rates between 1 and 3 mg/L/yr (Table D5); 24 wells had calculated increases at rates of less than 1 mg/L/yr; (Table D6) and 41 wells had decreasing chloride concentrations (Table D7).

Among the 68 wells that exhibited a rate of chloride increase greater than 1 mg/L/yr, the maximum contaminant level was exceeded prior to the year 2015 at only six wells and was projected to be exceeded by 2035 at only 11 additional wells. Thus, of these 68 wells, 75% (51 wells) were projected to remain below the SDWS through the planning period.

Statistically significant trends in TDS concentration were identified in groundwater at twenty-four wells exhibiting statistically significant chloride trends at the high (33) and medium (1) trend rates. The FDEP SDWS of 500 mg/L for TDS was exceeded prior to the year 2015 at 20 wells and was projected to be exceeded during the 20-year planning horizon at four wells. Forward projections could not be made for nine wells exhibiting trends in TDS concentration that were not statistically significant at the ≥ 95% SL.

The groundwater geochemistry was transitioning from characteristics of fresh water to saline water at 18 of the 92 wells with statistically significant trends in chloride concentration. All of the wells were water supply wells completed into the UFA (13) and multi-zone completed into the UFA and LFA (5). The groundwater geochemistry could not

be evaluated for eight wells because they were not sampled for laboratory chemical analyses of the major ion suite.

The rate of degradation due to SWI in groundwater has been reduced at some water supply wells through back-plugging of zones containing more mineralized groundwater that are responsible for salinity impacts (Figure D5). However, backplugging may eliminate higher transmissivity flow zones from the producing interval and result in reduced yields from affected water supply wells.

Conclusion

Statistically significant trends in chloride concentration, TDS concentration and groundwater geochemistry can be one factor to indicate the presence of groundwater degradation due to SWI. Thirty-three wells had an increasing chloride concentration at rates ≥ 3 mg/L/yr, and 35 wells had an increasing chloride concentration at rates within the range < 3 and ≥ 1 mg/L/yr. The sixty-eight wells with rates greater than 1 mg/L/yr occurred within four counties (Duval, Flagler, Nassau and St. Johns) in the SJRWMD portion of the NFRWSP area and were generally clustered along the St. Johns River and the Atlantic coastline (Figure D3). Sixty-five of these wells were FAS water supply wells and three were SAS water supply wells. SWI appears to be localized due to upconing in response to withdrawals of groundwater from wells and/or combined withdrawals from multiple wells.

When viewed in total, the primary conclusion of this analysis is that groundwater quality may constrain the availability of fresh groundwater in a relatively limited geographic area within the NFRWSP planning area – portions of Duval, Flagler, Nassau and St. Johns counties. Of the wells assessed, 75% of the wells identified as having increasing trends in chloride greater than 1 mg/L/yr were projected to still meet SDWS in 2035. For the remaining 25% of wells, GWQ could present a constraint on the availability of fresh groundwater. However, these concerns may be able to be managed through appropriate well construction and/or pumping operations because it is related to upconing and not lateral saltwater intrusion.

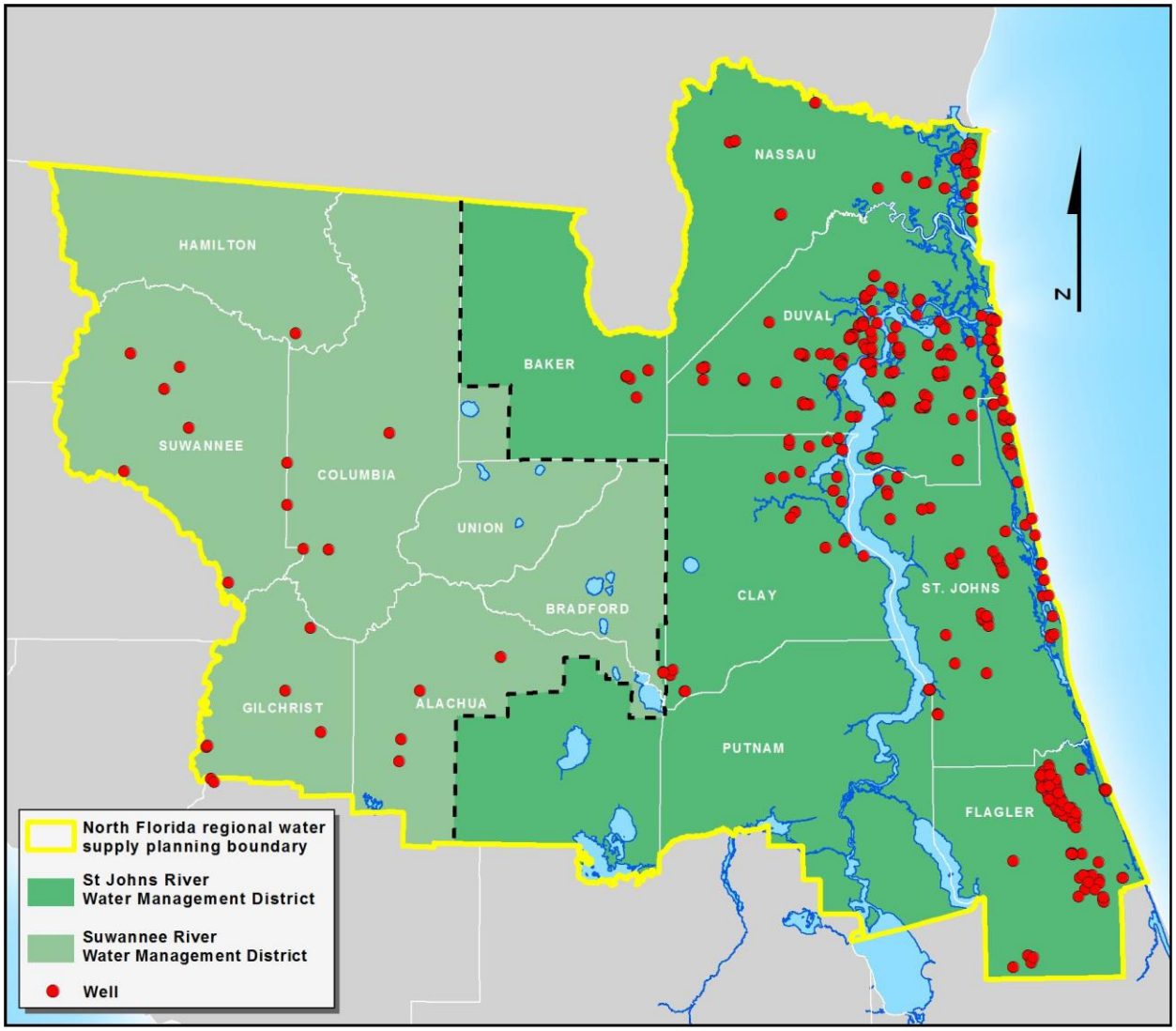

Figure D1: Wells Included in the North Florida Regional Water Supply Plan Groundwater Quality Analysis

Table D2: Summary of SJRWMD Consumptive Use Permits with Groundwater Quality Monitoring in the NFRWSP Area

County	CUP #	CUP Name	Main Use	Wellfield	Stations	Aquifer
Baker	15-11	Macclenny	Public Supply	Enterprise	1	UFA
				Knabb	1	UFA
				M-East	1	UFA
				M-West	2	UFA
Clay	416-48	Clay County Utility	Public Supply	Industrial	1	UFA LFA
				Green Cove Springs	1	UFA LFA
				Mid-Clay	1	UFA LFA
				Jennings	1	UFA LFA
				Orange Park	2	UFA LFA
				Pace Flemming	2	UFA LFA
	431-11	Clay County Utility Authority	Public Supply	Keystone Club	2	UFA
				Postmaster Village	2	UFA
				Keystone Heights	2	UFA
	453-6	Orange Park	Public Supply	Ash	2	UFA LFA
				Milwaukee	2	UFA LFA
	499-5	Green Cove Springs	Public Supply	Harbor Road	1	UFA
				Reynolds	1	UFA
	51227-7	Clay County Utility Authority Reuse	Public Supply	Flemming Island	1	UFA
					1	UFA LFA
				Mid-Clay	1	UFA
					1	UFA LFA
				Old Jennings Road	1	UFA LFA
				OPCC	1	UFA
				Spencer's Crossing	1	UFA LFA
	527-3	St Johns Landing	Household	NA	1	UFA
Duval	535-7	RockTenn	Commercial Industrial	NA	2	UFA LFA
	589-5	Mayport NAS	Public Supply	NA	4	UFA
	653-7	Reichhold Chemicals	Commercial Industrial	NA	1	UFA LFA
	716-5	Renessenz	Commercial Industrial	NA	5	UFA
	721-6	JEA NGS	Power Generation	NA	4	UFA LFA
	793-3	Jacksonville Beach	Public Supply	NA	2	UFA
				NA	1	UFA LFA
	810-7	Atlantic Beach	Public Supply	Buccaneer	3	UFA
				WTP 1	1	UFA
				WTP 2	2	UFA
				WWTP 1	1	UFA
	861-2	US Gypsum	Commercial Industrial	NA	1	UFA
	913-2	Anheuser-Bush	Commercial Industrial	NA	1	UFA
	50247-6	NAS Jacksonville	Public Supply	NA	2	UFA LFA

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County	CUP #	CUP Name	Main Use	Wellfield	Stations	Aquifer
Duval (cont.)	51629-1	JEA Brandy Branch	Power Generation	NA	3	UFA LFA
	88271-12	JEA	Public Supply	Lofton Oaks	1	UFA
				Nassau Regional	2	UFA
				Otter Run	2	UFA
				West Nassau Regional	1	UFA LFA
				Mayport	2	UFA LFA
				Cecil Commerce	3	UFA LFA
				Fairfax	6	UFA LFA
				Highlands	6	UFA LFA
				Lakeshore	5	UFA LFA
				Main Street	7	UFA LFA
				Marietta	4	UFA LFA
				McDuff	5	UFA LFA
				Norwood	4	UFA LFA
				Southwest	5	UFA LFA
				Westlake	1	UFA
				A1A	2	UFA
				Ponce de Leon	2	UFA
				Corona	2	UFA
				Ponte Vedra North	1	UFA
				9A-9B	2	UFA LFA
				Arlington	4	UFA
					1	UFA LFA
				Beacon Hills	2	UFA LFA
				Brierwood	1	UFA
					4	UFA LFA
				Community Hall	3	UFA
					1	UFA LFA
				Deerwood 3	6	UFA
					2	UFA LFA
				Hendricks	8	UFA LFA
				Julington Creek	2	UFA
				Lovegrove	3	UFA
				Monument	2	UFA
				Oakridge	5	UFA
					1	UFA LFA
				Power Park	6	FAS
				Ridenour	7	UFA
				Royal Lakes	2	UFA LFA
				Southeast	3	UFA
				St Johns Forest	2	UFA
				St Johns North	3	UFA
				Woodmere	1	UFA
	90722-1	Jacksonville University	Public Supply	NA	1	UFA

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County	CUP #	CUP Name	Main Use	Wellfield	Stations	Aquifer
Duval (cont.)	38-7	Dee Dot Timberlands	Recreational	Fort Davis Lake	1	UFA LFA
				Skinner Lake	1	UFA LFA
	647-6	CertainTeed Gypsum	Commercial Industrial	NA	1	UFA
	702-10	Hidden Hills	Golf Course Irrigation	NA	1	UFA
				NA	1	UFA LFA
	708-6	Bacardi	Commercial Industrial	NA	2	UFA LFA
	756-4	Neighborhood Utilities	Public Supply	NA	1	UFA
	784-4	Baldwin	Public Supply	NA	3	UFA
	804-3	Jacksonville Beach Golf Course	Golf Course Irrigation	NA	1	UFA
	842-5	Neptune Beach	Public Supply	NA	4	UFA LFA
	862-4	Swisher	Commercial Industrial	NA	1	UFA
	863-7	Gerdau Ameristeel	Commercial Industrial	NA	1	UFA
	867-2	Evergreen Cemetary	Landscape Irrigation	NA	1	UFA
	892-3	Eastcoast Oils	Landscape Irrigation	NA	1	UFA
	903-3	Simplex	Household	NA	1	UFA LFA
	50124-8	Queens Harbor Yacht & Country Club	Golf Course Irrigation	NA	1	UFA
	50333-4	Jacksonville Zoological Gardens	Recreational	NA	1	UFA
Flagler	59-4	Flagler Beach	Public Supply	NA	3	UFA
	65-4	Shannon Strickland Sod	Agriculture Irrigation	NA	1	UFA
	1947-6	Palm Coast	Public Supply	WTP 1	31	SAS
				WTP 2	8	UFA
				WTP 3	20	SAS
	1982-5	Bunnell	Public Supply	NA	3	SAS
				NA	3	UFA
	12247-2	Pro-Gro Turf Farm	Agriculture Irrigation	NA	1	UFA
	1960-7	Plantation Bay	Public Supply	NA	4	UFA
	1984-9	Flagler County Nursery	Nursery Irrigation	NA	5	UFA
	2002-2	Bulow Village Campground	Public Supply	NA	3	UFA
	51136-3	Dunes CDD	Public Supply	NA	6	UFA
	70714-4	Hammock Dunes	Golf Course Irrigation	NA	2	UFA

Table D2: Summary of SJRWMD Consumptive Use Permits with Groundwater Quality Monitoring in the NFRWSP Area

County	CUP #	CUP Name	Main Use	Wellfield	Stations	Aquifer
Nassau	102129-1	Seay Farm	Agriculture Irrigation	NA	1	UFA
	122-6	Fernandina Beach	Public Supply	WTP 1	2	UFA LFA
				WTP 2	2	UFA LFA
				WTP 3	2	UFA
	915-4	Rayonier	Commercial Industrial	NA	10	UFA
	948-7	Hilliard	Public Supply	NA	4	UFA
	955-8	White Oak Plantation	Public Supply	NA	1	UFA
	970-6	Amelia River Golf Club	Golf Course Irrigation	NA	1	UFA
	50077-6	RockTenn	Commercial Industrial	NA	7	UFA
	50087-7	Amelia Island	Public Supply	NA	3	UFA
	50272-8	Amelia Island Plantation	Golf Course Irrigation	NA	1	UFA
	922-5	Callahan	Public Supply	NA	2	UFA
	930-3	Fernandina Beach Municipal Golf Course	Golf Course Irrigation	NA	1	UFA
Putnam	7963-6	Anguilla Fish Farm	Aquaculture	NA	7	UFA
St Johns	157-5	North Beach	Public Supply	NA	1	UFA
	1142-14	SJCUD Ponte Vedra	Public Supply	Inlet Beach	4	UFA
				Marsh Landing	2	UFA
				Plantation	4	UFA
				Sawgrass	2	UFA
	1198-3	SJCUD Tillman Ridge & Northwest	Public Supply	NA	3	UFA
				NA	8	UFA
	50299-5	St Augustine	Public Supply	NA	7	UFA
	1092-4	J Leighton Middleton	Agriculture Irrigation	NA	1	UFA
	1158-7	St Augustine Alligator Farm	Recreational	NA	1	UFA
	1309-4	Beach Farms	Agriculture Irrigation	NA	1	UFA
	1314-5	Cookman, Shop & New Ground Farm	Agriculture Irrigation	NA	1	UFA
	1358-5	Guana River WMA	Recreational	NA	2	UFA
	1360-10	Cimarrone Golf & Country Club	Golf Course Irrigation	NA	1	UFA
	1381-4	Camachee Island	Public Supply	NA	2	UFA
	1386-6	Porpoise Point	Public Supply	NA	1	UFA
	1392-4	Town of Hastings	Public Supply	NA	2	UFA
	1422-6	Slammer & Squire Golf Course	Golf Course Irrigation	NA	1	UFA
	1423-3	Fruit Cove Oaks	Public Supply	NA	1	UFA

Table D2: Summary of SJRWMD Consumptive Use Permits with Groundwater Quality Monitoring in the NFRWSP Area

County	CUP #	CUP Name	Main Use	Wellfield	Stations	Aquifer
St Johns (cont.)	1498-2	Marsh Creek Owner's Association	Public Supply	NA	3	UFA
	50827-4	Palencia Club & Golf Course	Golf Course Irrigation	NA	1	UFA
	65726-2	Bartram Tail HS	Landscape Irrigation	NA	1	UFA

Table D3: Summary of SRWMD Observation Well Network with Groundwater Quality Monitoring in the NFRWSP Area

County	Station Name	Station Number	Aquifer
Alachua	Betty Truluck	S101713003	UFA
	Ernest Bliss	S081912004	UFA
	George Yates	S081833003	UFA
	Leo Hines	S091736001	UFA
Columbia	DOT SR47	S061610001	UFA
	Ichetucknee SP	S061607001	UFA
	Lake City	S031734011	UFA
	S&S Food #44	S051511002	UFA
	William Mosley	S041523001	UFA
Gilchrist	DOT Maint Office	S071630002	UFA
	Loncala	S091628005	UFA
	Otter Springs 4	S101406011	UFA
	Otter Springs P1	S101405004	UFA
	Rayonier WACCA	S081535002	UFA
Hamilton	Bullock Tower	S011535004	UFA
Levy	Fanning Springs 2	S101429021	UFA
	Fanning Springs 4	S101429023	UFA
Suwannee	Bill Hadden	S041227001	UFA
	Carrol Hall	S061434006	UFA
	DOT SR129	S031335002	UFA
	Leroy Hurst	S031305005	UFA
	Richard Brown Jr	S021215001	UFA
	Suwannee Co CC	S021322008	UFA

Table D4: Results of Groundwater Quality Analyses for Wells Demonstrating an Increasing Chloride Trend of >3mg/L/year at a 95% Significance Level

County	CUP #	CUP Name	Station	Aquifer	Segment	POR	Analyte	Sample Size	Min (mg/L)	Max (mg/L)	Median (mg/L)	Mode	Median Slope (mg/L/yr)	τ	p-value	SL	DWS	Groundwater Geochemistry	
Duval	88271-12	JEA	PW 3 (14728)	UFA	1	2002.00 2014.50	Cl^-	44	15.8	141	113	Quarterly	3.0	0.379	0.0002	99%	>2035	$(Ca,Mg)(HCO_3,SO_4,Cl)$	T
							TDS	43	369	920	575	Quarterly	1.2	0.055	0.6100	NS	NA		
Duval	88271-12	JEA	PW 1 (6033)	UFA LFA	1	2004.50 2014.50	Cl^-	30	64.6	147	88.5	Quarterly	3.1	0.457	0.0002	99%	>2035	$(Ca,Mg)(HCO_3,SO_4,Cl)$	T
							TDS	30	428	597	482	Quarterly	3.0	0.228	0.0802	80%	NA		
Duval	88271-12	JEA	PW 2 (6034)	UFA LFA	1	2004.50 2014.50	Cl^-	30	61.3	334	130	Quarterly	13.6	0.531	0.0002	99%	2019	$(Ca,Mg,Na)(HCO_3,SO_4,Cl)$	T
							TDS	30	439	956	568	Quarterly	24.9	0.483	0.0002	99%	<2015		
Duval	88271-12	JEA	PW 6004 (22525)	UFA LFA	3	2012.00 2014.50	Cl^-	11	95.7	157	150	Quarterly	9.1	0.545	0.0238	95%	2024	$(Ca,Mg)(SO_4,Cl)$	
							TDS	11	675	812	740	Quarterly	49.3	0.582	0.0156	95%	<2015		
Duval	88271-12	JEA	PW 5703 (6099)	UFA	2	2004.50 2014.50	Cl^-	30	46.1	109	79.6	Quarterly	5.5	0.706	0.0002	99%	>2035	$(Ca,Mg)(HCO_3,SO_4,Cl)$	
							TDS	30	449	685	577	Quarterly	14.5	0.598	0.0002	99%	<2015		
Duval	88271-12	JEA	PW 5704 (6100)	UFA	3	2007.75 2014.50	Cl^-	24	37.5	108	97.5	Quarterly	4.0	0.591	0.0002	99%	>2035	$(Ca,Mg)(HCO_3,SO_4,Cl)$	
							TDS	24	456	654	578	Quarterly	13.5	0.580	0.0002	99%	<2015		
Duval	88271-12	JEA	PW 5701 (6097)	UFA LFA	1	1998.00 2014.50	Cl^-	43	14.0	184	95.2	Quarterly	8.2	0.856	0.0002	99%	2026	$(Ca,Mg)(SO_4,Cl)$	T
							TDS	43	200	780	612	Quarterly	16.7	0.668	0.0002	99%	<2015		
Duval	88271-12	JEA	PW 5706 (22540)	UFA LFA	2	2006.75 2014.50	Cl^-	32	14.8	173	67.7	Quarterly	14.1	0.837	0.0002	99%	2023	$(Ca,Mg)(HCO_3,SO_4,Cl)$	T
							TDS	32	421	676	495	Quarterly	27.5	0.744	0.0002	99%	<2015		
Duval	88271-12	JEA	PW 2 (5894)	UFA	3	2007.00 2014.50	Cl^-	27	136	352	212	Quarterly	22.9	0.718	0.0002	99%	<2015	(Ca,Mg,Na)Cl	T
							TDS	27	201	954	721	Quarterly	34.4	0.681	0.0002	99%	<2015		
Duval	88271-12	JEA	PW 5301 (6060)	UFA	4	2009.50 2014.50	Cl^-	21	48.9	126	89.6	Quarterly	15.0	0.719	0.0002	99%	2022	$(Ca,Mg,Na)(HCO_3,SO_4,Cl)$	T
							TDS	21	432	612	521	Quarterly	22.9	0.629	0.0002	99%	<2015		
Duval	88271-12	JEA	PW 5304 (6063)	UFA LFA	1	1998.00 2014.50	Cl^-	51	15.9	235	130	Quarterly	7.1	0.705	0.0002	99%	2025	$(Ca,Mg,Na)(HCO_3,SO_4,Cl)$	T
							TDS	51	305	737	564	Quarterly	11.3	0.614	0.0002	99%	<2015		

Table D4: Results of Groundwater Quality Analyses for Wells Demonstrating an Increasing Chloride Trend of >3mg/L/year at a 95% Significance Level

County	CUP #	CUP Name	Station	Aquifer	Segment	POR	Analyte	Sample Size	Min (mg/L)	Max (mg/L)	Median (mg/L)	Mode	Median Slope (mg/L/yr)	τ	p-value	SL	DWS	Groundwater Geochemistry	
Duval	88271-12	JEA	PW 5902 (22568)	UFA	3	2007.50 2014.50	Cl^-	14	63.1	106	76.1	Quarterly	6.2	0.527	0.0098	95%	>2035	$(Ca,Mg)(HCO_3,SO_4,Cl)$	T
							TDS	14	450	566	497	Quarterly	17.3	0.538	0.0086	95%	<2015		
Duval	88271-12	JEA	PW 5905 (34485)	UFA	2	2005.25 2013.50	Cl^-	28	16.5	73.9	32.3	Quarterly	4.7	0.526	0.0002	99%	>2035	$Ca(HCO_3,SO_4)$	
							TDS	28	378	468	422	Quarterly	8.7	0.593	0.0002	99%	2018		
Duval	88271-12	JEA	PW 5907 (34487)	UFA	1	2008.25 2014.50	Cl^-	23	24.9	70.4	40.0	Quarterly	4.0	0.601	0.0002	99%	>2035	$Ca(HCO_3,SO_4)$	
							TDS	23	353	481	428	Quarterly	11.0	0.605	0.0002	99%	2018		
Duval	88271-12	JEA	PW A (5946)	UFA LFA	2	2005.75 2014.50	Cl^-	33	36.0	76.1	54.7	Quarterly	3.3	0.489	0.0002	99%	>2035	$(Ca,Mg)SO_4$	
							TDS	33	310	674	590	Quarterly	6.5	0.322	0.0088	95%	<2015		
Duval	702-10	Hidden Hills	PW ARL13 (6212)	UFA	1	2004.75 2014.50	Cl^-	15	50.0	140	100	Quarterly	6.4	0.648	0.0008	99%	2034	$(Ca,Mg)(HCO_3,SO_4,Cl)$	T
							TDS	14	400	556	511	Quarterly	8.6	0.297	0.1528	NS	NA		
Flagler	59-4	Flagler Beach	PW 10 (34525)	UFA	1	2009.00 2014.25	Cl^-	22	28.0	660	99.5	Quarterly	28.4	0.810	0.0002	99%	2016	NA	NA
							TDS	22	410	1100	550	Quarterly	60.0	0.766	0.0002	99%	<2015		
Flagler	59-4	Flagler Beach	PW 11 (34526)	UFA	1	2009.00 2014.25	Cl^-	22	31.0	340	100	Quarterly	30.9	0.926	0.0002	99%	2016	NA	NA
							TDS	22	410	680	575	Quarterly	52.6	0.848	0.0002	99%	<2015		
Flagler	1947-6	Palm Coast	PW LW23 (35373)	UFA	1	2006.75 2014.00	Cl^-	30	77	130	100	Quarterly	4.4	0.575	0.0002	99%	>2035	NA	NA
							TDS	30	460	600	550	Quarterly	9.2	0.409	0.0014	99%	<2015		
Flagler	1947-6	Palm Coast	PW LW31 (6640)	UFA	2	2004.75 2014.00	Cl^-	38	43	290	142	Quarterly	18.9	0.701	0.0002	99%	2015	NA	NA
							TDS	32	410	1000	665	Quarterly	51.5	0.613	0.0002	99%	<2015		
Flagler	1947-6	Palm Coast	PW 3 (6916)	UFA	1	2005.25 2013.25	Cl^-	13	14.8	86.0	48.5	Quarterly	5.1	0.487	0.0238	95%	>2035	$Ca(HCO_3)_2$	
							TDS	13	262	500	366	Quarterly	13.4	0.321	0.1416	NS	NA		
Nassau	50077-6	RockTenn	PW 4 (11386)	UFA	3	2012.75 2014.25	Cl^-	7	32.6	40.0	38.8	Quarterly	3.4	0.810	0.0108	95%	>2035	$(Ca,Mg)(SO_4,HCO_3)$	
							TDS	7	469	610	494	Quarterly	24.0	0.524	0.1360	NS	NA		

Table D4: Results of Groundwater Quality Analyses for Wells Demonstrating an Increasing Chloride Trend of >3mg/L/year at a 95% Significance Level

County	CUP #	CUP Name	Station	Aquifer	Segment	POR	Analyte	Sample Size	Min (mg/L)	Max (mg/L)	Median (mg/L)	Mode	Median Slope (mg/L/yr)	τ	p-value	SL	DWS	Groundwater Geochemistry	
Nassau	50077-6	RockTenn	PW 9 (11380)	UFA	3	2013.25 2014.25	Cl^-	5	55.2	88.0	64.8	Quarterly	32.4	1.000	0.0166	95%	2019	$(Ca,Mg)(SO_4,HCO_3)$	
							TDS	5	490	610	495	Quarterly	38.0	0.200	0.8160	NS	NA		
Nassau	930-3	Fernandina Beach Municipal Golf Course	PW B (11434)	UFA	1	2003.75 2014.25	Cl^-	20	25.1	110	78.0	Quarterly	5.4	0.653	0.0002	99%	>2035	$(Ca,Mg,Na)(HCO_3,SO_4,Cl)$	T
							TDS	20	472	611	530	Quarterly	8.6	0.600	0.0002	99%	<2015		
St Johns	1142-14	SJCUD Ponte Vedra	PW IB2 (14818)	UFA	2	2008.75 2014.00	Cl^-	20	27.0	66.6	45.3	Quarterly	5.4	0.668	0.0002	99%	>2035	$(Ca,Mg)(HCO_3,SO_4)$	
							TDS	20	400	1130	449	Quarterly	12.5	0.484	0.0030	99%	2015		
St Johns	1142-14	SJCUD Ponte Vedra	PW IB4 (33882)	UFA	1	2002.25 2014.00	Cl^-	36	18.0	69.9	35.0	Quarterly	3.1	0.625	0.0002	99%	>2035	$(Ca,Mg)(SO_4,HCO_3)$	
							TDS	36	328	1190	454	Quarterly	6.1	0.359	0.0022	99%	2016		
St Johns	1142-14	SJCUD Ponte Vedra	PW SG1 (14640)	UFA	2	2009.25 2013.25	Cl^-	13	20.5	51.0	28.2	Quarterly	4.3	0.538	0.0124	95%	>2035	$(Ca,Mg)(SO_4,HCO_3)$	
							TDS	12	356	476	444	Quarterly	17.0	0.500	0.0278	90%	NA		
St Johns	1198-3	SJCUD Northwest & Tillman Ridge	PW NW2 (34245)	UFA	2	2008.75 2014.25	Cl^-	23	23.8	49.5	35.4	Quarterly	3.0	0.474	0.0016	99%	>2035	$(Ca,Mg)SO_4$	
							TDS	23	406	600	534	Quarterly	4.0	0.079	0.6170	NS	NA		
St Johns	1198-3	SJCUD Northwest & Tillman Ridge	PW TR42 (14780)	UFA	3	2010.75 2014.25	Cl^-	12	244	327	271	Quarterly	18.1	0.773	0.0006	99%	<2015	(Ca,Mg,Na)Cl	T
							TDS	12	914	1010	962	Quarterly	24.0	0.515	0.0232	95%	<2015		
St Johns	1198-3	SJCUD Northwest & Tillman Ridge	PW TR43 (34240)	UFA	1	2004.75 2014.25	Cl^-	39	267	463	368	Quarterly	18.3	0.749	0.0002	99%	<2015	(Ca,Mg,Na)Cl	T
							TDS	39	932	1500	1120	Quarterly	15.4	0.429	0.0002	99%	<2015		
St Johns	1198-3	SJCUD Northwest & Tillman Ridge	PW TR45 (34242)	UFA	1	2007.25 2014.25	Cl^-	29	250	555	346	Quarterly	27.9	0.569	0.0002	99%	<2015	(Ca,Mg,Na)Cl	T
							TDS	29	804	1870	1100	Quarterly	40.0	0.384	0.0036	99%	<2015		
St Johns	1198-3	SJCUD Northwest & Tillman Ridge	PW TR46 (34243)	UFA	2	2012.00 2014.25	Cl^-	10	198	412	290	Quarterly	79.2	0.778	0.0010	99%	<2015	(Ca,Mg,Na)Cl	T
							TDS	10	866	1080	990	Quarterly	81.8	0.578	0.0226	95%	<2015		
St Johns	1198-3	SJCUD Northwest & Tillman Ridge	PW TR48 (38399)	UFA	1	2009.25 2014.25	Cl^-	18	200	314	256	Quarterly	12.7	0.542	0.0018	99%	<2015	(Ca,Mg,Na)Cl	T
							TDS	18	710	992	931	Quarterly	5.3	0.150	0.4066	NS	NA		

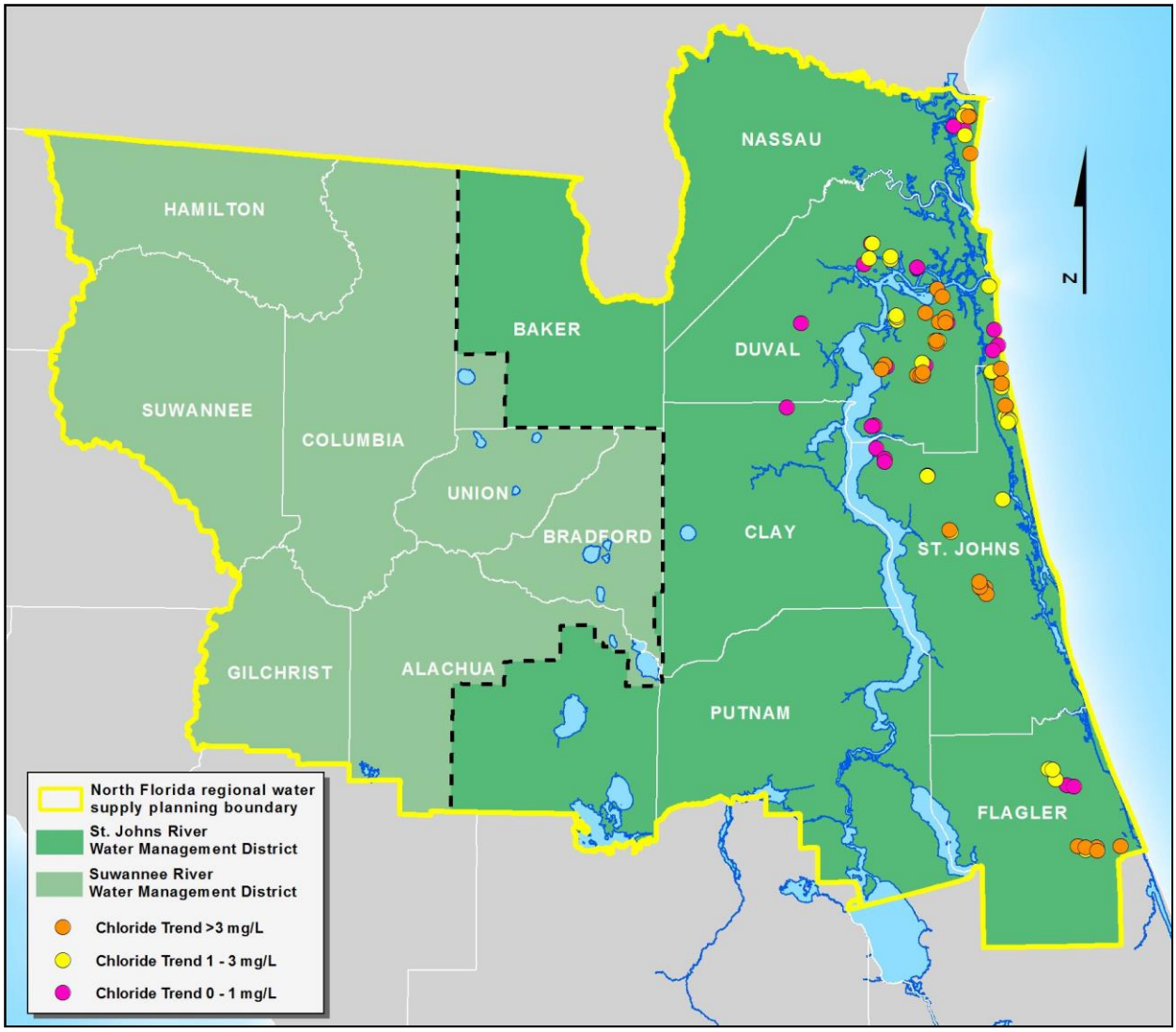


Figure D2: Subset of Analyzed Wells that Showed Statistically Significant Increasing Chloride Concentration Trends

Table D5: Results of Groundwater Quality Analyses for Wells Demonstrating an Increasing Chloride Trend of <3mg/L/year and >1mg/L/year at a 95% Significance Level

County	CUP #	CUP Name	Station	Aquifer	Segment	POR	Analyte	Sample Size	Min (mg/L)	Max (mg/L)	Median (mg/L)	Mode	Median Slope (mg/L/yr)	τ	p-value	SL	DWS	Groundwater Geochemistry	
Duval	535-7	RockTenn	PW 7 (5801)	UFA LFA	1	2003.00 2010.00	Cl^-	14	34.0	51.5	44.6	Quarterly	2.4	0.857	0.0002	99%	>2035	$Ca(HCO_3,SO_4)$	
Duval	535-7	RockTenn	PW 9 (5803)	UFA LFA	2	2007.25 2014.25	Cl^-	14	33.0	52.5	39.6	Quarterly	2.1	0.780	0.0002	99%	>2035	$Ca(HCO_3,SO_4)$	
Duval	589-5	Mayport NAS	PW 3 (5924)	UFA	2	2008.00 2014.00	Cl^-	45	19.5	36.0	24.0	Yearly	2.8	0.810	0.0108	95%	>2035	$(Ca,Mg)(SO_4,HCO_3)$	
Duval	913-2	Anheuser-Bush	PW 3 (6570)	UFA	1	2003.75 2010.75	Cl^-	14	23.0	34.0	26.0	Quarterly	1.2	0.747	0.0002	99%	>2035	$(Ca,Mg)(HCO_3)_2$	
Duval	88271-12	JEA	PW 5402 (6085)	UFA	3	2007.00 2012.75	Cl^-	24	56.3	93.5	76.2	Quarterly	2.9	0.359	0.0150	95%	>2035	$Ca(HCO_3,SO_4,Cl)$	
Duval	88271-12	JEA	PW 5403 (6086)	UFA LFA	2	1998.50 2014.50	Cl^-	46	84.0	177	115	Quarterly	2.3	0.635	0.0002	99%	>2035	$(Ca,Mg)(HCO_3,SO_4,Cl)$	
Duval	88271-12	JEA	PW 5404 (6087)	UFA	2	1999.50 2014.50	Cl^-	46	99.9	210	193	Quarterly	2.4	0.500	0.0002	99%	2032	$(Ca,Mg)Cl_2$	T
							TDS	46	430	810	665	Quarterly	8.0	0.390	0.0002	99%	<2015		
Duval	88271-12	JEA	PW 5405 (6088)	UFA	1	1998.25 2013.75	Cl^-	41	25.0	111	86.8	Quarterly	2.8	0.691	0.0002	99%	>2035	$Ca(HCO_3,SO_4,Cl)$	
Duval	88271-12	JEA	PW 5406 (34488)	UFA	1	2010.00 2014.50	Cl^-	19	32.5	41.8	35.3	Quarterly	1.8	0.801	0.0002	99%	>2035	$(Ca,Mg)(SO_4,HCO_3)$	
Duval	88271-12	JEA	PW 5705 (22539)	UFA	3	2011.50 2014.50	Cl^-	13	44.4	50.8	48.0	Quarterly	1.4	0.526	0.0146	95%	>2035	$(Ca,Mg)(SO_4,HCO_3)$	
Duval	88271-12	JEA	PW 5707 (35645)	UFA	1	2005.25 2014.50	Cl^-	34	14.5	80.4	21.5	Quarterly	1.3	0.676	0.0002	99%	>2035	$(Ca,Mg)SO_4$	
Duval	88271-12	JEA	PW 5302 (6061)	UFA	3	2004.50 2014.50	Cl^-	36	12.9	77.2	39.0	Quarterly	2.7	0.516	0.0002	99%	>2035	$(Ca,Mg)(SO_4,HCO_3)$	
Duval	88271-12	JEA	PW 5305 (6064)	UFA	5	2010.50 2014.50	Cl^-	16	53.7	65.5	59.2	Quarterly	1.9	0.475	0.0118	95%	>2035	$Ca(SO_4,HCO_3)$	
Duval	88271-12	JEA	PW 5904 (34484)	UFA	1	2004.00 2013.50	Cl^-	32	13.7	37.2	22.3	Quarterly	1.5	0.526	0.0002	99%	>2035	$Ca(HCO_3,SO_4)$	
Duval	88271-12	JEA	PW 5906 (34486)	UFA	1	2006.25 2014.50	Cl^-	30	14.3	40.4	18.4	Quarterly	1.1	0.632	0.0002	99%	>2035	$Ca(HCO_3,SO_4)$	
Duval	88271-12	JEA	PW B (5947)	UFA LFA	2	2005.75 2014.50	Cl^-	33	25.8	109	39.0	Quarterly	1.0	0.491	0.0002	99%	>2035	$CaSO_4$	
Duval	88271-12	JEA	PW 1D (15112)	UFA	1	2002.75 2014.50	Cl^-	38	19.9	44.3	33.8	Quarterly	1.9	0.700	0.0002	99%	>2035	$CaSO_4$	
Duval	708-6	Bacardi	PW 1 (6213)	UFA LFA	3	2006.75 2014.25	Cl^-	13	19.0	29.5	23.0	Quarterly	1.1	0.577	0.0068	95%	>2035	$Ca(HCO_3)_2$	
Flagler	1947-6	Palm Coast	PW SW60	SAS	1	1995.00 2014.50	Cl^-	77	14.0	130	102	Quarterly	1.9	0.389	0.0002	99%	>2035	NA	NA
Flagler	1947-6	Palm Coast	PW SW62	SAS	1	1995.00 2014.50	Cl^-	74	11.0	91.0	72.5	Quarterly	1.3	0.431	0.0002	99%	>2035	NA	NA

Table D5: Results of Groundwater Quality Analyses for Wells Demonstrating an Increasing Chloride Trend of <3mg/L/year and >1mg/L/year at a 95% Significance Level

County	CUP #	CUP Name	Station	Aquifer	Segment	POR	Analyte	Sample Size	Min (mg/L)	Max (mg/L)	Median (mg/L)	Mode	Median Slope (mg/L/yr)	τ	p-value	SL	DWS	Groundwater Geochemistry	
Flagler	1947-6	Palm Coast	PW SW114	SAS	1	1995.00 2014.50	Cl^-	76	15	130	86.5	Quarterly	2.7	0.600	0.0002	99%	>2035	NA	NA
Flagler	1947-6	Palm Coast	PW LW21	UFA	4	2007.00 2014.00	Cl^-	29	25	62	34.0	Quarterly	2.0	0.502	0.0002	99%	>2035	NA	NA
Nassau	915-4	Rayonier	PW 6 (11392)	UFA	1	1993.50 2014.25	Cl^-	79	25.0	180.0	55.0	Quarterly	1.8	0.590	0.0002	99%	>2035	$Ca(HCO_3,SO_4)$	
Nassau	50077-6	RockTenn	PW 6 (11385)	UFA	1	2006.00 2013.25	Cl^-	28	44.0	73.0	61.0	Quarterly	2.9	0.667	0.0002	99%	>2035	$(Ca,Mg)(SO_4,HCO_3)$	
Nassau	50077-6	RockTenn	PW 8 (11379)	UFA	1	2006.50 2014.25	Cl^-	32	36.0	83.3	52.2	Quarterly	1.6	0.542	0.0002	99%	>2035	$(Ca,Mg)(SO_4,HCO_3)$	
St Johns	1142-14	SJCUD Ponte Vedra	PW IB3 (14820)	UFA	1	2000.50 2014.00	Cl^-	43	16.9	58.2	29.0	Quarterly	1.3	0.507	0.0002	99%	>2035	$(Ca,Mg)(SO_4,HCO_3)$	
St Johns	1142-14	SJCUD Ponte Vedra	PW ML1 (34049)	UFA	2	2004.50 2014.00	Cl^-	30	9.70	52.9	31.8	Quarterly	2.8	0.743	0.0002	99%	>2035	$(Ca,Mg)(SO_4,HCO_3)$	
St Johns	1142-14	SJCUD Ponte Vedra	PW ML2 (14822)	UFA	2	2005.75 2013.75	Cl^-	25	8.50	36.4	20.0	Quarterly	1.5	0.477	0.0010	99%	>2035	$(Ca,Mg)SO_4$	
St Johns	1142-14	SJCUD Ponte Vedra	PW PL1 (14641)	UFA	1	2003.00 2014.00	Cl^-	35	13.0	59.0	26.0	Quarterly	1.8	0.568	0.0002	99%	>2035	$(Ca,Mg)(SO_4,HCO_3)$	
St Johns	1142-14	SJCUD Ponte Vedra	PW PL2 (14642)	UFA	1	2003.00 2014.00	Cl^-	38	8.50	49.0	23.0	Quarterly	1.8	0.563	0.0002	99%	>2035	$(Ca,Mg)(SO_4,HCO_3)$	
St Johns	1142-14	SJCUD Ponte Vedra	PW PL3 (24083)	UFA	1	2003.00 2014.00	Cl^-	39	17.5	53.7	25.0	Quarterly	1.6	0.641	0.0002	99%	>2035	$(Ca,Mg)SO_4$	
St Johns	1142-14	SJCUD Ponte Vedra	PW PL4 (24084)	UFA	1	2003.00 2014.00	Cl^-	37	13.7	40.4	21.0	Quarterly	1.3	0.626	0.0002	99%	>2035	$(Ca,Mg)SO_4$	
St Johns	1142-14	SJCUD Ponte Vedra	PW SG2 (15110)	UFA	1	2003.00 2014.00	Cl^-	37	16.7	54.8	28.3	Quarterly	1.5	0.517	0.0002	99%	>2035	$(Ca,Mg)SO_4$	
St Johns	1198-3	SJCUD Tillman Ridge & NW	PW NW1 (34244)	UFA	2	2008.75 2014.25	Cl^-	22	26.5	51.1	36.9	Quarterly	2.7	0.429	0.0056	95%	>2035	$(Ca,Mg)SO_4$	
St Johns	50827-4	Palencia Club & Golf	PW 1 (31899)	UFA	1	2001.75 2013.75	Cl^-	25	71.0	89.0	78.0	Quarterly	1.0	0.627	0.0002	99%	>2035	$(Ca,Mg,Na)(HCO_3,SO_4,Cl)$	T

Table D6: Results of Groundwater Quality Analyses for Wells Demonstrating an Increasing Chloride Trend of <1mg/L/year at a 95% Significance Level

County	CUP #	CUP Name	Station	Aquifer	Segment	POR	Analyte	Sample Size	Min (mg/L)	Max (mg/L)	Median (mg/L)	Mode	Median Slope (mg/L/yr)	τ	p-value	SL	DWS	Groundwater Geochemistry
Clay	416-48	Clay County Utility	PW SC-3 (35195)	UFA LFA	1	2004.00 2014.25	Cl^-	23	1.50	9.30	4.70	Quarterly	0.27	0.474	0.0016	99%	>2035	$(Ca,Mg)(HCO_3)_2$
Duval	721-6	JEA NGS	PW 2 (6237)	UFA LFA	1	1984.00 2014.50	Cl^-	115	15.0	47.8	21.9	Quarterly	0.1	0.245	0.0002	99%	>2035	$Ca(HCO_3)_2$
Duval	721-6	JEA NGS	PW 3 (6238)	UFA LFA	1	1984.00 1997.00	Cl^-	114	19.5	61.9	30.1	Quarterly	0.5	0.205	0.0012	99%	>2035	$(Ca,Mg)(HCO_3)_2$
Duval	793-3	Jacksonville Beach	PW 15 (6345)	UFA	1	2002.50 2014.25	Cl^-	41	9.20	13.0	12.0	Quarterly	0.2	0.357	0.0006	99%	>2035	$(Ca,Mg)SO_4$
Duval	51629-1	JEA Brandy Branch	PW 3 (22280)	UFA LFA	1	2005.75 2014.25	Cl^-	33	6.96	9.90	8.59	Quarterly	0.11	0.333	0.0068	95%	>2035	$Ca(HCO_3)_2$
Duval	88271-12	JEA	PW 601 (6125)	UFA LFA	1	1998.00 2014.25	Cl^-	33	15.6	28.0	19.8	Quarterly	0.1	0.236	0.0104	95%	>2035	$Ca(HCO_3)_2$
Duval	88271-12	JEA	PW 702 (6149)	UFA LFA	1	1998.00 2014.50	Cl^-	54	8.10	56.1	9.49	Quarterly	0.05	0.232	0.0136	95%	>2035	$Ca(SO_4,HCO_3)$
Duval	88271-12	JEA	PW 6002 (22523)	UFA LFA	1	1999.75 2014.50	Cl^-	51	11.9	19.0	14.9	Quarterly	0.2	0.482	0.0002	99%	>2035	$CaSO_4$
Duval	88271-12	JEA	PW 6003 (22524)	UFA LFA	1	2000.00 2014.50	Cl^-	48	12.0	81.9	15.6	Quarterly	0.4	0.597	0.0002	99%	>2035	$CaSO_4$
Duval	88271-12	JEA	PW M503 (6093)	UFA LFA	1	1998.00 2014.50	Cl^-	54	8.65	14.2	10.1	Quarterly	0.05	0.282	0.0026	99%	>2035	$Ca(HCO_3,SO_4)$
Duval	88271-12	JEA	PW M504 (6094)	UFA	1	1998.00 2005.00	Cl^-	57	8.18	13.4	9.44	Quarterly	0.07	0.331	0.0002	99%	>2035	$Ca(HCO_3,SO_4)$
Duval	88271-12	JEA	PW 5708 (38533)	UFA	1	2006.25 2014.50	Cl^-	26	12.9	51.3	19.3	Quarterly	0.5	0.345	0.0142	95%	>2035	$CaSO_4$
Duval	88271-12	JEA	PW 5901 (22567)	UFA	1	1998.25 2014.50	Cl^-	51	12.3	38.5	17.0	Quarterly	0.2	0.305	0.0016	99%	>2035	$Ca(HCO_3,SO_4)$
Duval	88271-12	JEA	PW 2D (15114)	UFA	1	2003.00 2014.50	Cl^-	41	13.5	42.8	24.1	Quarterly	0.7	0.480	0.0002	99%	>2035	$CaSO_4$
Duval	88271-12	JEA	PW 3 (22058)	UFA	1	2002.50 2014.50	Cl^-	43	11.8	24.6	15.5	Quarterly	0.4	0.520	0.0002	99%	>2035	$(Ca,Mg)SO_4$
Duval	88271-12	JEA	PW 4 (22059)	UFA	1	2002.50 2014.50	Cl^-	43	11.0	23.4	13.3	Quarterly	0.2	0.433	0.0002	99%	>2035	$(Mg,Ca)SO_4$
Duval	708-6	Bacardi	PW 2 (33092)	UFA LFA	2	2006.75 2014.25	Cl^-	16	19.0	35.0	24.0	Quarterly	0.8	0.583	0.0016	99%	>2035	$Ca(HCO_3)_2$
Duval	804-3	Jacksonville Beach Golf	PW 1 (6363)	UFA	1	2001.00 2014.25	Cl^-	52	9.70	14.4	12.0	Quarterly	0.1	0.244	0.0090	95%	>2035	$(Ca,Mg)SO_4$
Duval	842-5	Neptune Beach	PW 4D (6416)	UFA LFA	2	2004.25 2014.50	Cl^-	39	31.0	46.0	35.0	Quarterly	0.7	0.641	0.0002	99%	>2035	$(Ca,Mg)(HCO_3,SO_4)$
Flagler	1947-6	Palm Coast	PW SW14 (6655)	SAS	1	1995.00 2014.50	Cl^-	73	13.0	76.0	51	Quarterly	0.6	0.339	0.0002	99%	>2035	NA
Flagler	1947-6	Palm Coast	PW SW29-29R (104677)	SAS	1	1995.00 2014.50	Cl^-	75	11	54	26	Quarterly	0.3	0.299	0.0002	99%	>2035	NA

Table D6: Results of Groundwater Quality Analyses for Wells Demonstrating an Increasing Chloride Trend of <1mg/L/year at a 95% Significance Level

County	CUP #	CUP Name	Station	Aquifer	Segment	POR	Analyte	Sample Size	Min (mg/L)	Max (mg/L)	Median (mg/L)	Mode	Median Slope (mg/L/yr)	τ	p-value	SL	DWS	Groundwater Geochemistry	
Nassau	915-4	Rayonier	PW 7 (11393)	UFA	1	1993.50 2014.25	Cl^-	79	24.0	44.0	32.0	Quarterly	0.3	0.394	0.0002	99%	>2035	$(Ca,Mg)(HCO_3,SO_4)$	
Nassau	915-4	Rayonier	PW 15 (11401)	UFA	1	1993.50 2014.25	Cl^-	79	28.0	95.0	38.0	Quarterly	0.5	0.195	0.0114	95%	>2035	$(Ca,Mg)(HCO_3,SO_4)$	
St Johns	1423-3	Fruit Cove Oaks	PW 1 (15202)	UFA	1	2000.75 2013.75	Cl^-	23	10.0	32.2	16.0	Quarterly	0.9	0.684	0.0002	99%	>2035	$(Mg,Ca)SO_4$	

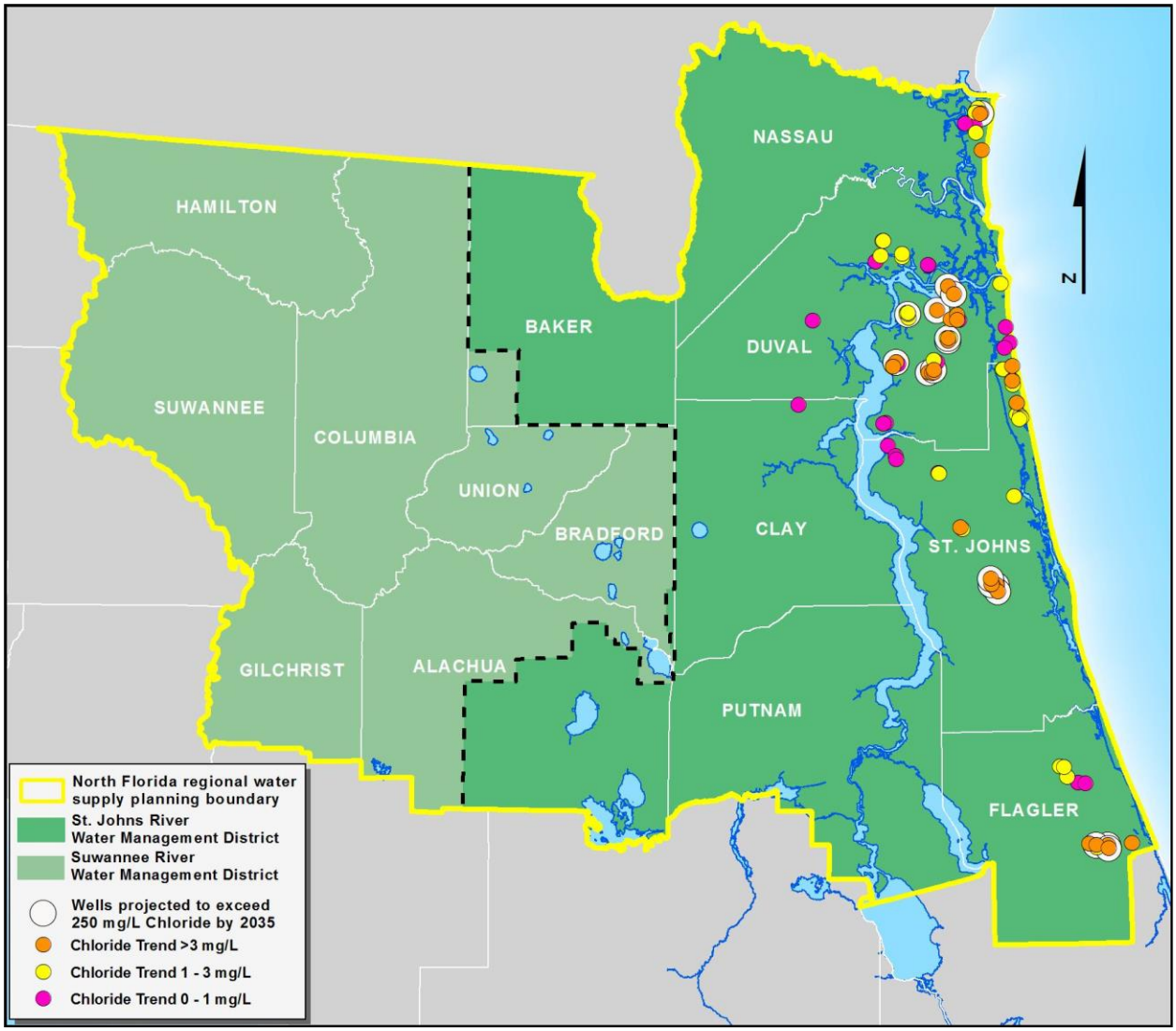
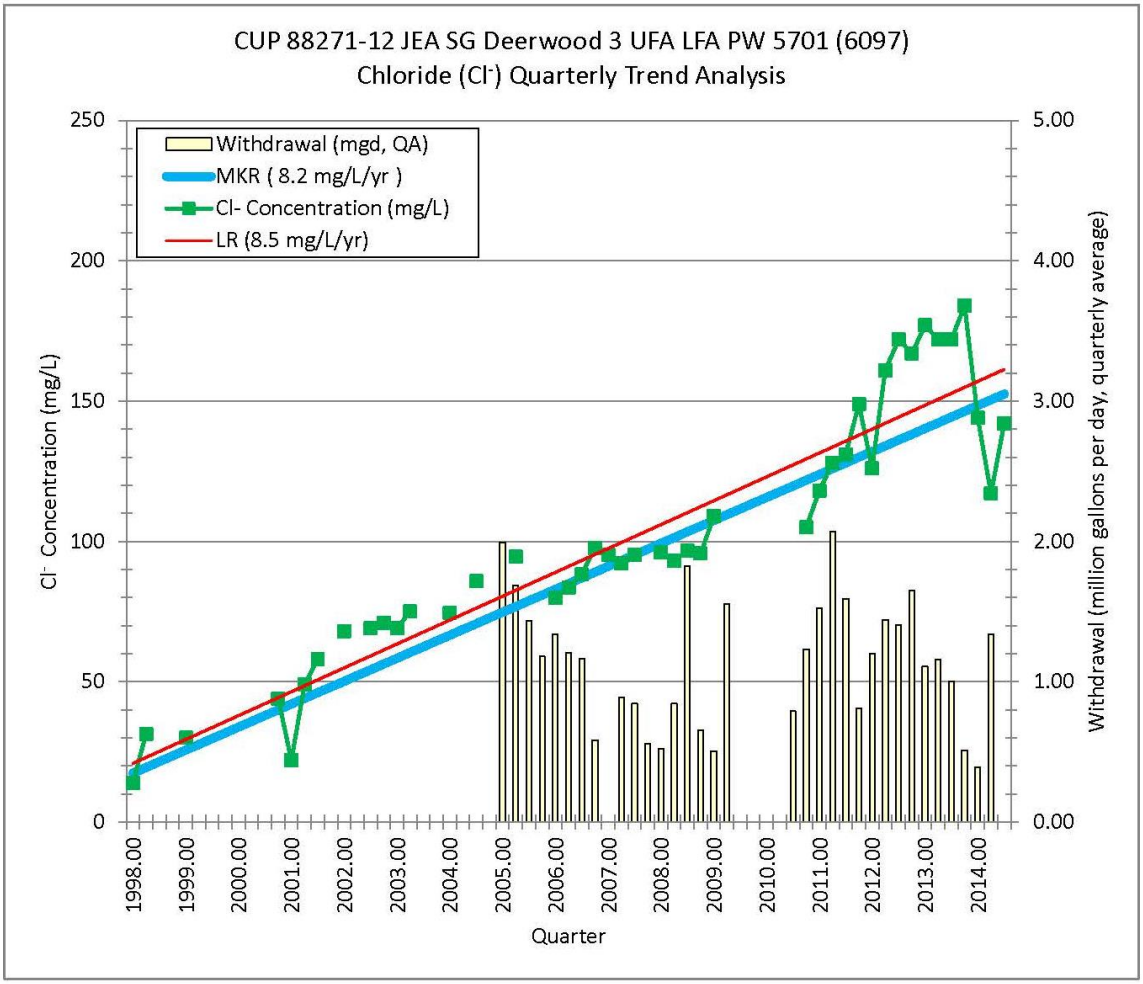


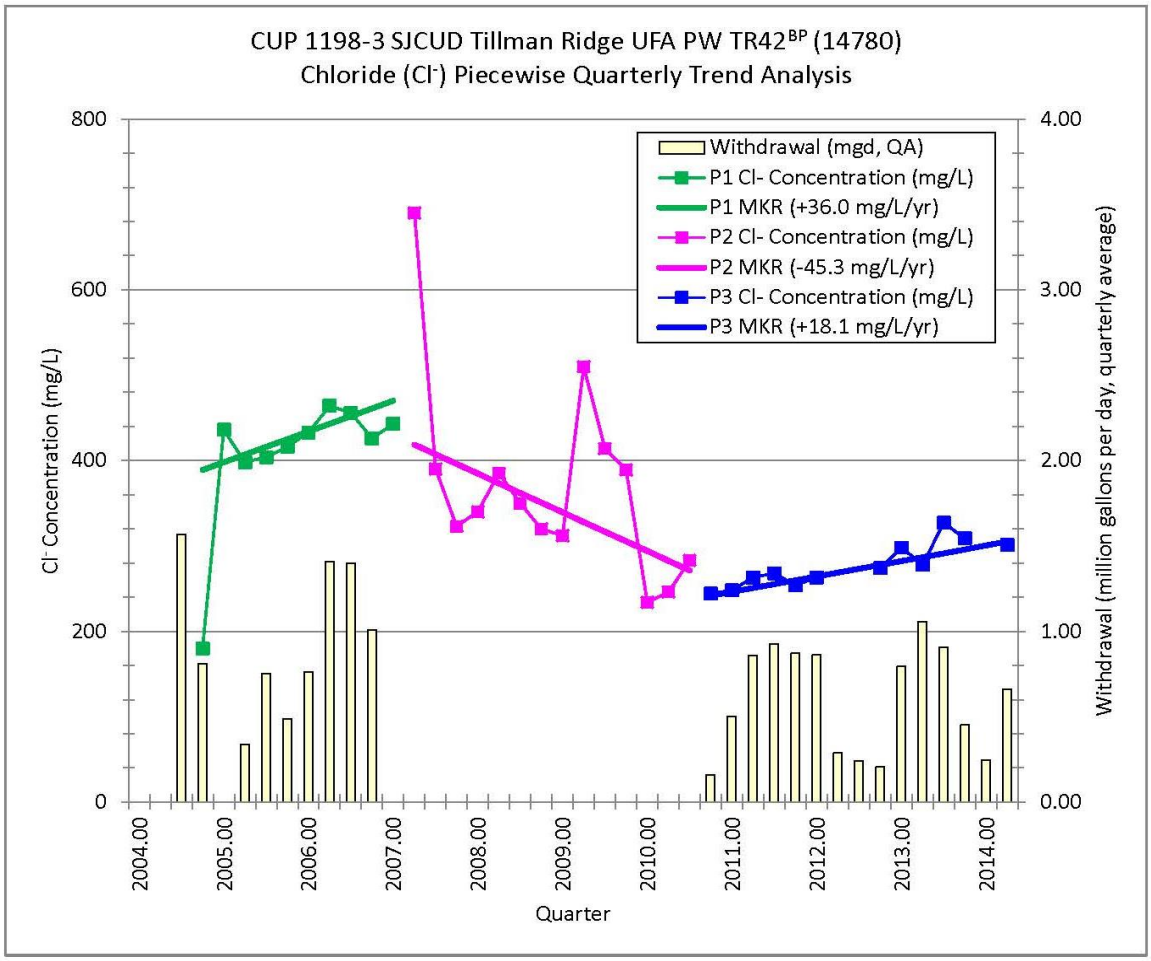
Figure D3: Wells with Trends in Chloride Concentration Projected to Exceed 250 mg/L Chloride by 2035



POR	Minimum (mg/L)	Maximum (mg/L)	Mode	Median Slope (mg/L/yr)	τ	p-value	Significance Level
1998.00 2014.50	14.0	184	Quarterly	8.2	0.856	0.0002	99%

Significance Level	One-Tailed p-Value α	Two-Tailed p-value α/2	Comments
99%	0.01	0.005	Very confident about trend
95%	0.05	0.025	Confident about trend
90%	0.10	0.050	A trend probably exists
80%	0.20	0.100	Watch
NS	>0.20	>0.100	Not significant

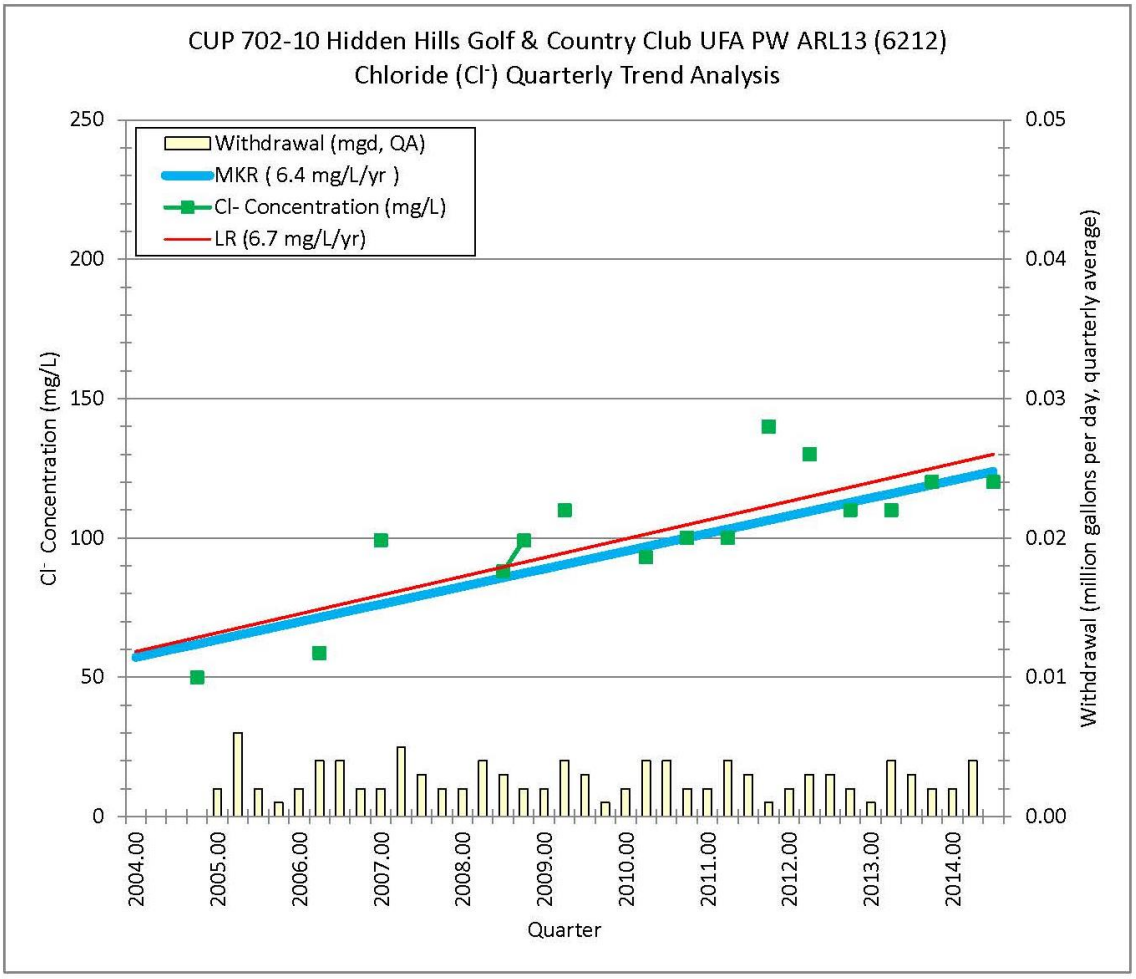
Figure D4: Time-Series Chloride Trend in a Jacksonville Electric Authority Production Well



POR	Minimum (mg/L)	Maximum (mg/L)	Mode	Median Slope (mg/L/yr)	τ	p-value	Significance Level
2004.75 2007.00	180	464	Quarterly	36.0	0.511	0.0460	90%
2007.25 2010.50	234	690	Quarterly	-45.3	-0.385	0.0628	80%
2010.75 2014.25	244	327	Quarterly	18.1	0.773	0.0006	99%

Significance Level	One-Tailed p-Value α	Two-Tailed p-value α/2	Comments
99%	0.01	0.005	Very confident about trend
95%	0.05	0.025	Confident about trend
90%	0.10	0.050	A trend probably exists
80%	0.20	0.100	Watch
NS	>0.20	>0.100	Not significant

Figure D5: Time-Series Chloride Trend in a St. Johns County Production Well



POR	Minimum (mg/L)	Maximum (mg/L)	Mode	Median Slope (mg/L/yr)	τ	p-value	Significance Level
2004.75 2014.50	50.0	140	Quarterly	6.4	0.648	0.0008	99%

Significance Level	One-Tailed p-Value α	Two-Tailed p-value α/2	Comments
99%	0.01	0.005	Very confident about trend
95%	0.05	0.025	Confident about trend
90%	0.10	0.050	A trend probably exists
80%	0.20	0.100	Watch
NS	>0.20	>0.100	Not significant

Figure D6a: Time-Series Chloride Trend in a Hidden Hills Golf and Country Club Well

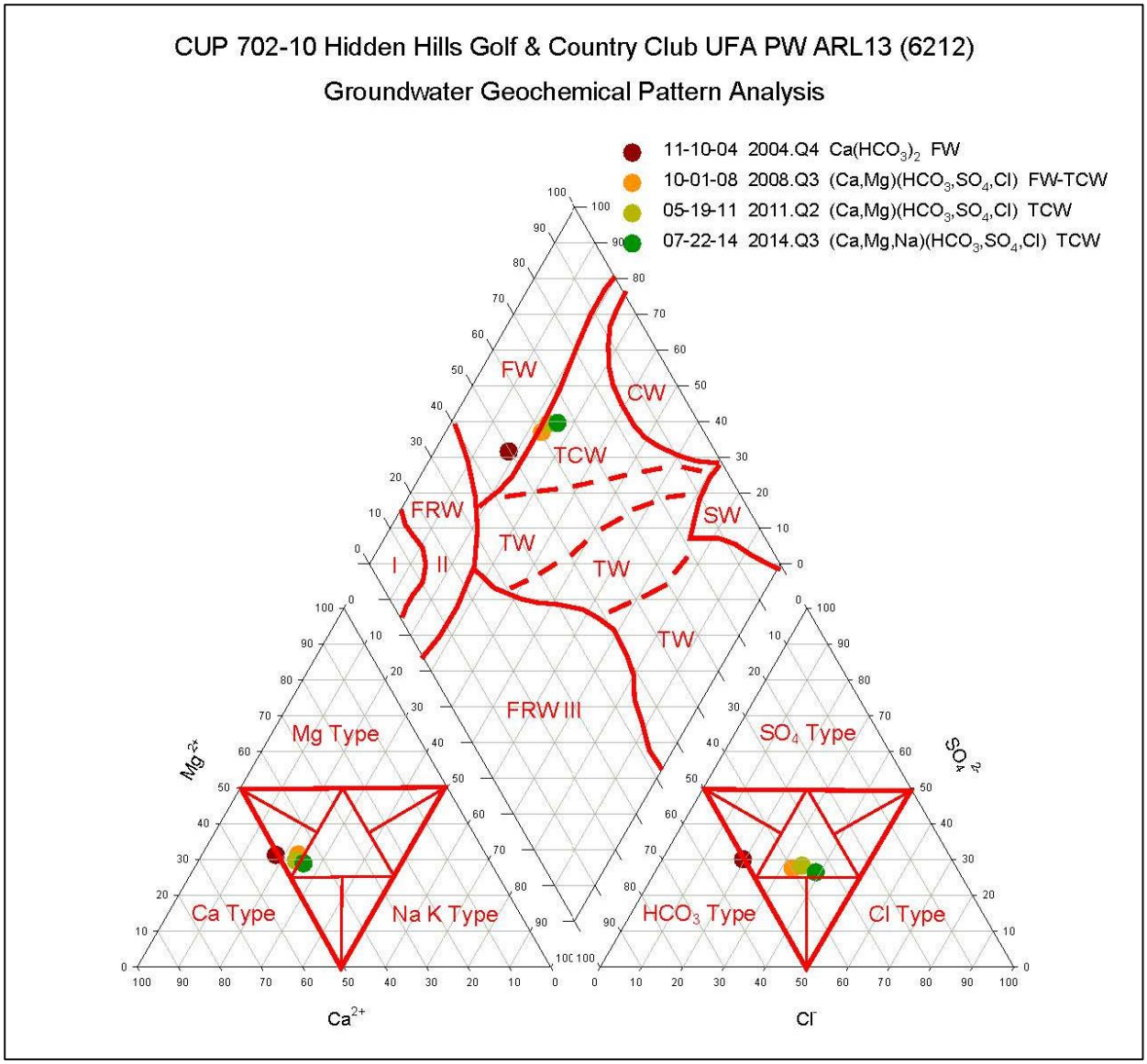


Figure D6b: Piper-trilinear Diagram for Groundwater Geochemical Pattern Analysis for a Hidden Hill Golf and Country Club Production Well

Table D7: Results of Groundwater Quality Analyses for Wells Demonstrating a Decreasing Chloride Trend at a 95% Significance Level

County	CUP #	CUP Name	Station	Aquifer	Segment	POR	Cl^- Min (mg/L)	Cl^- Max (mg/L)	Mode	Cl^- Median Slope (mg/L/yr)	τ	p-value	SL
Alachua	NA	Ernest Bliss	MW S081912004	UFA	5	2010.25 2012.25	8.90	13.0	Quarterly	-2.1	-1.000	0.0028	99%
Columbia	NA	DOT SR47	MW S061610001	UFA	1	2000.75 2013.75	4.00	7.70	Quarterly	-0.09	-0.270	0.0052	95%
Duval	589-5	Mayport NAS	PW 1R (33450)	UFA	3	2007.25 2014.25	13.0	38.0	Quarterly	-2.3	-0.478	0.0002	99%
Duval	810-7	Atlantic Beach	PW 2 (6377)	UFA	1	2003.25 2014.25	11.6	130	Quarterly	-3.9	-0.524	0.0010	99%
Duval	88271-12	JEA	PW 8A03 (6208)	UFA LFA	1	1998.25 2014.50	13.8	21.5	Quarterly	-0.1	-0.340	0.0006	99%
Duval	88271-12	JEA	PW 501 (6117)	UFA LFA	1	1998.00 2014.50	7.20	44.2	Quarterly	-0.04	-0.266	0.0104	95%
Duval	88271-12	JEA	PW 503 (6120)	UFA LFA	1	1998.25 2014.50	7.23	20.0	Quarterly	-0.08	-0.246	0.0094	95%
Duval	88271-12	JEA	PW 505 (6115)	UFA LFA	1	1998.00 2014.50	6.37	20.0	Quarterly	-0.08	-0.237	0.0102	95%
Duval	88271-12	JEA	PW 5201 (6052)	UFA	4	2008.75 2014.50	22.4	30.0	Quarterly	-0.8	-0.533	0.0002	99%
Duval	88271-12	JEA	PW 5204 (6055)	UFA	3	2007.50 2014.50	13.5	19.9	Quarterly	-0.3	-0.470	0.0010	99%
Duval	88271-12	JEA	PW A	FA	3	1996.50 2014.50	21.1	74.4	Quarterly	-0.3	-0.520	0.0002	99%
Duval	88271-12	JEA	PW B	FA	2	1996.25 2014.50	22.0	65.3	Quarterly	-0.8	-0.492	0.0002	99%
Duval	88271-12	JEA	PW C	FA	2	1996.50 2014.50	21.5	81.5	Quarterly	-0.6	-0.407	0.0024	99%
Flagler	1947-6	Palm Coast	PW SW5-SW5R (105005)	SAS	1	1995.00 2014.50	14	62	Quarterly	-0.5	-0.385	0.0002	99%
Flagler	1947-6	Palm Coast	PW SW7 (6652)	SAS	1	1995.00 2014.50	22	88	Quarterly	-0.9	-0.328	0.0002	99%
Flagler	1947-6	Palm Coast	PW SW27 (6656)	SAS	1	1995.00 2014.50	15	53	Quarterly	-1.0	-0.605	0.0002	99%
Flagler	1947-6	Palm Coast	PW SW30 (6659)	SAS	1	1995.00 2014.50	17	65	Quarterly	-1.3	-0.473	0.0002	99%
Flagler	1947-6	Palm Coast	PW SW31 (6660)	SAS	1	1995.00 2014.50	10	51	Quarterly	-0.4	-0.282	0.0002	99%
Flagler	1947-6	Palm Coast	PW SW32 (6661)	SAS	1	1995.00 2014.50	9.0	78.0	Quarterly	-1.5	-0.626	0.0002	99%
Flagler	1947-6	Palm Coast	PW SW33 (6662)	SAS	1	1995.00 2014.50	8.0	55.0	Quarterly	-0.3	-0.277	0.0002	99%
Flagler	1947-6	Palm Coast	PW SW35 (6664)	SAS	1	1995.00 2014.50	4	58	Quarterly	-0.6	-0.371	0.0002	99%
Flagler	1947-6	Palm Coast	PW SW36 (6665)	SAS	1	1995.00 2014.50	8.0	101	Quarterly	-0.3	-0.258	0.0008	99%

Table D7: Results of Groundwater Quality Analyses for Wells Demonstrating a Decreasing Chloride Trend at a 95% Significance Level

County	CUP #	CUP Name	Station	Aquifer	Segment	POR	Cl^- Min (mg/L)	Cl^- Max (mg/L)	Mode	Cl^- Median Slope (mg/L/yr)	τ	p-value	SL
Flagler	1947-6	Palm Coast	PW SW42 (6647)	SAS	1	2004.00 2014.50	20	47	Quarterly	-0.5	-0.432	0.0002	99%
Flagler	1947-6	Palm Coast	PW SW43 (6620)	SAS	1	2001.75 2014.50	20	62	Quarterly	-0.6	-0.323	0.0008	99%
Flagler	1947-6	Palm Coast	PW SW59 (6667)	SAS	1	1995.00 2014.50	7	73	Quarterly	-1.1	-0.407	0.0002	99%
Flagler	1947-6	Palm Coast	PW SW61 (6668)	SAS	1	1995.00 2014.50	10	78	Quarterly	-1.1	-0.363	0.0002	99%
Flagler	1947-6	Palm Coast	PW SW83 (6628)	SAS	1	2005.00 2014.50	24	45	Quarterly	-0.7	-0.438	0.0002	99%
Flagler	1947-6	Palm Coast	PW SW38 (35378)	SAS	1	2007.50 2014.25	21	28	Quarterly	-0.7	-0.538	0.0002	99%
Flagler	1982-5	Bunnell	PW W3 (6832)	SAS	1	2005.00 2014.00	21.4	140	Quarterly	-0.7	-0.526	0.0012	99%
Flagler	1982-5	Bunnell	PW W4 (6833)	SAS	1	2005.00 2014.00	23.0	378	Quarterly	-6.8	-0.356	0.0188	95%
Flagler	1960-7	Plantation Bay	PW 2 (6748)	UFA	1	2006.25 2013.75	19.6	32.3	Quarterly	-0.6	-0.689	0.0046	99%
Nassau	122-6	Fernandina Beach	PW 6 (54)	UFA LFA	1	2001.25 2014.25	28.0	148	Quarterly	-1.5	-0.335	0.0174	95%
Nassau	122-6	Fernandina Beach	PW 7 (55)	UFA LFA	1	2001.25 2014.25	29.0	370	Quarterly	-1.4	-0.332	0.0182	95%
Nassau	915-4	Rayonier	PW 5 (11391)	UFA	1	1993.50 2014.25	26.0	52.0	Quarterly	-0.2	-0.381	0.0002	99%
Nassau	915-4	Rayonier	PW 9 (11395)	UFA	1	2005.00 2014.25	25.0	53.0	Quarterly	-0.5	-0.451	0.0002	99%
Nassau	915-4	Rayonier	PW 11 (11397)	UFA	1	1993.50 2014.25	25.0	36.0	Quarterly	-0.2	-0.433	0.0002	99%
Nassau	915-4	Rayonier	PW 12 (11398)	UFA	2	2005.50 2014.25	24.0	29.0	Quarterly	-0.2	-0.294	0.0110	95%
Nassau	915-4	Rayonier	PW 14 (11400)	UFA	1	2000.50 2014.25	29.0	90.3	Quarterly	-1.0	-0.532	0.0002	99%
Nassau	50087-7	Amelia Island	PW 1 (11419)	UFA	1	2004.25 2014.25	17.0	31.0	Quarterly	-0.4	-0.351	0.0024	99%
Nassau	50087-7	Amelia Island	PW 2 (11420)	UFA	1	2004.25 2014.25	20.0	32.0	Quarterly	-0.3	-0.303	0.0090	95%
Suwannee	NA	Carrol Hall	MW S061434006	UFA	1	2004.25 2013.75	9.90	17.7	Quarterly	-0.46	-0.472	0.0002	99%