Warm Mineral Springs
Sampling by Sarasota County

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Sarasota, Florida

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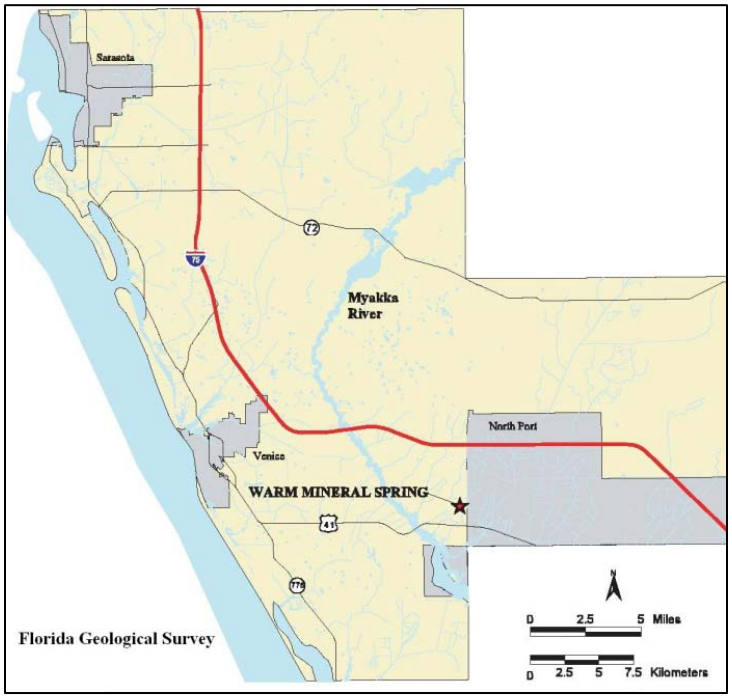
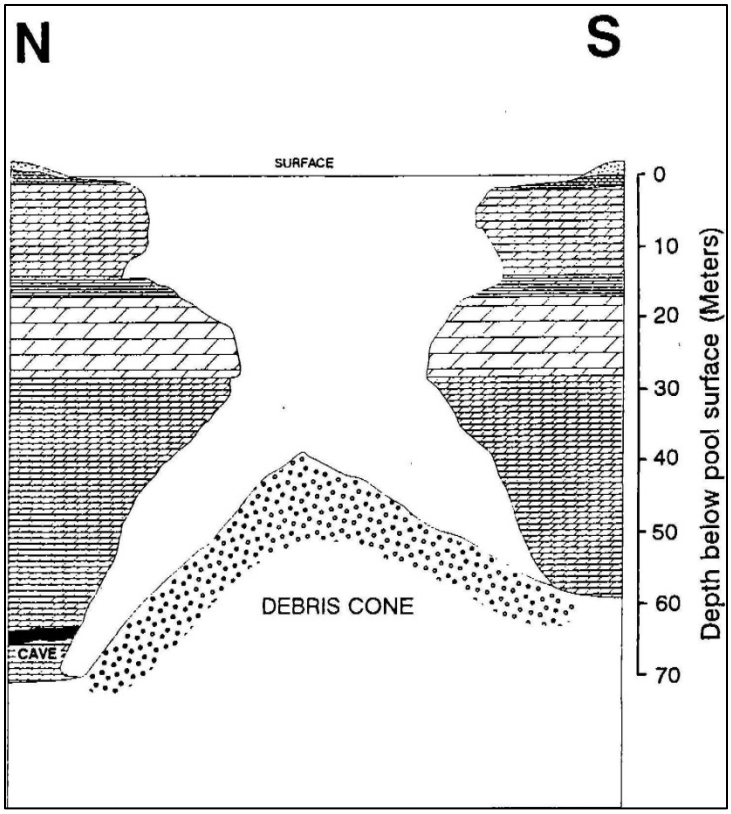
Sarasota County

Warm Mineral Springs is a spring-fed sinkhole located near North Port, Florida. The main flow enters the sinkhole from a vent at the base of the north wall. The spring run flows southwest to the Myakka River. Significant archeological finds have been recovered from the site.





On the morning of September 14, 2011 water quality sampling was conducted at Warm Mineral Springs. A depth profile was taken in about 15-foot increments from the surface down to 130 feet. The objective of the project was to establish a baseline condition in support of management activities. The depth profile approach was used to determine if the spring was stratified. Minerals and metals were included in the study to characterize the geologic source of the warm, salty water.

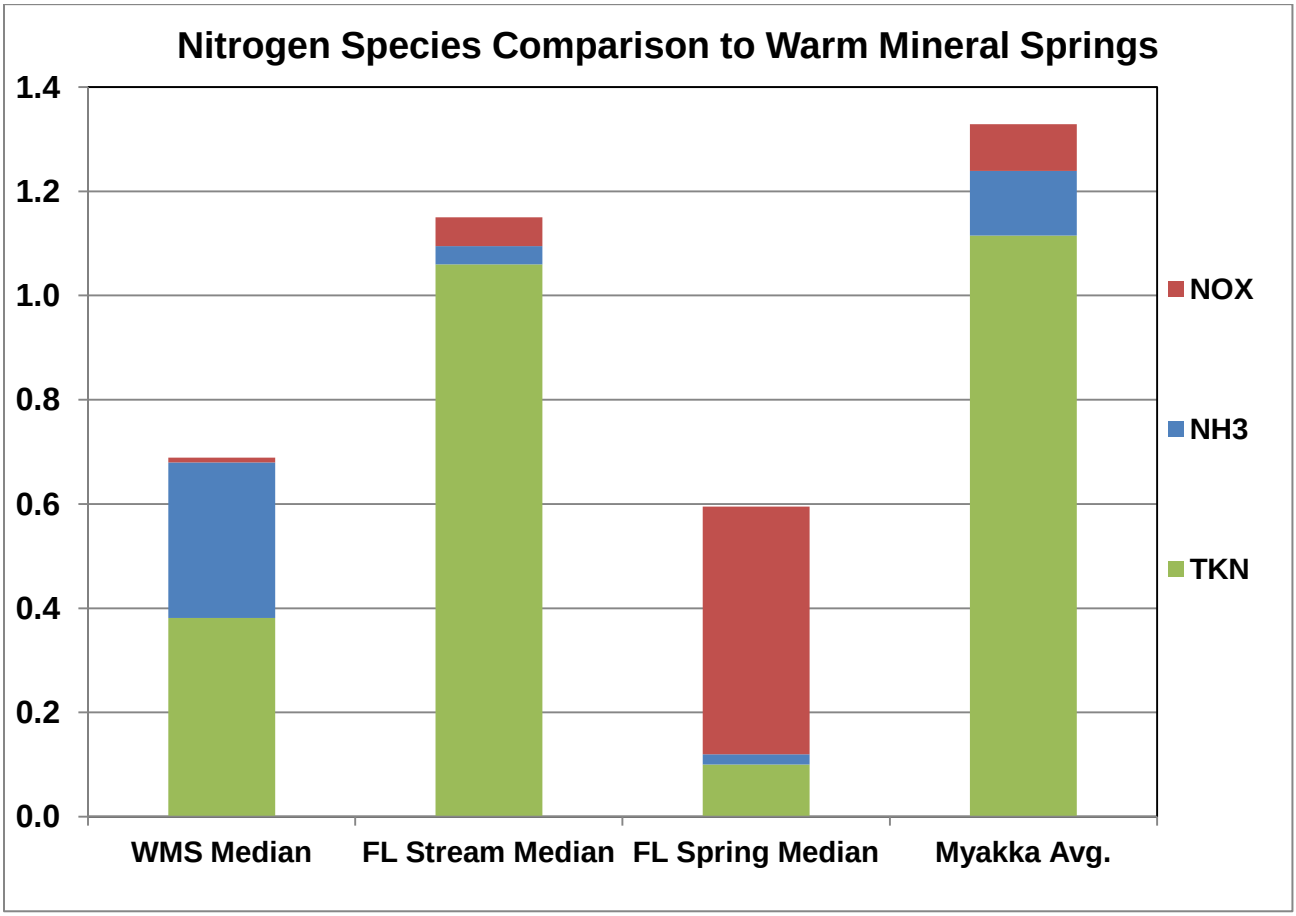
Results Summary

Warm Mineral Springs is a unique waterbody which makes it difficult to assess in comparison to other surface waters. Nevertheless this report offers comparisons to help illustrate the water quality of this special place. The results are just a snapshot of conditions from one time. The clarity of WMS is reported to vary at times so other conditions are also presumably variable.

Warm Mineral Springs is not stratified; there is little or no layering. It is mineralized and is about half the salinity of seawater. The temperature was 86 degrees Fahrenheit, much warmer that the 72 degree water often found in Florida springs. It is clean - with low concentrations of bacteria, turbidity, color, biochemical oxygen demand, chlorophyll (algae), suspended solids and metals. The dissolved oxygen level is very low, which is common in groundwater.

The total nitrogen level in Warm Mineral Springs is not high compared to other springs or streams or the Myakka River. The proportion of ammonia is high and the proportion of nitrate-nitrite is low. Total and ortho-phosphorus levels are higher than most Florida springs but are consistent with phosphate rich surface waters in the Sarasota area. Chlorophyll A was not detected in the spring but pheophytin was.

The water quality of Warm Mineral Springs is largely unknown. Trends in temperature, mineral content, human influence, of water flow volumes can be accurately determined by the implementation of a well-constructed monitoring program. A multi-year program of routine monthly sampling of water coming into the main spring vent could be used to determine trends over seasonal time periods and would document changes during dry and wet weather. Continuous metering of water quality would capture changes that occur in between the monthly sampling events. Water level monitoring in the spring run can be correlated to rating curve to assess trends in flow.



General Parameters

	Median	FL Stream Median	FL Spring Median	Minimum Detection Limit	Practical Quantitation Limit	Myakka River
Temperature (F)	85.8	73.4	71.8	.	.	74.2

Specific Conductance (umhos/cm)	30,652	475	374	.	.	0.59
Salinity (ppt)	18.9	0.5	0.0	.	.	0.3
Total Dissolved Solids (mg/l)	19180.0	.	.	7.3	29.0	.
Enterococci (cfu/100ml)	Not Detected	.	.	10	10	.
Fecal coliform (cfu/100ml)	Not Detected	60	10	10	10	981
Turbidity (NTU)	0.42	2.50	0.30	0.05	0.05	4.07
Total Suspended Solids (mg/l)	1.50	4.00	1.00	0.57	2.28	5.15
Color (PCU)	5.0	80.0	5.0	2.5	2.5	182
Secchi Depth (m)	9.5	.	.	.	.	.
Dissolved Oxygen (mg/l)	1.3	5.5	1.8	.	.	5.8
Dissolved Oxygen Saturation (%)	18.7	62.0	23.8	.	.	66.0
Biochemical Oxygen Demand (mg/l)	Not Detected	1.3	0.6	0.5	2.0	1.2

pH	7.0	7.2	7.3	.	.	7.1

Nutrients

	Median (ug/l)	FL Stream Median	FL Spring Median	Minimum Detection Limit	Practical Quantitation Limit	Myakka River
Ammonia	0.299	0.035	0.020	0.008	0.032	0.124
Nitrate + Nitrite	0.010	0.071	1.060	0.004	0.016	0.089
Total Kjeldahl Nitrogen	0.381	1.060	0.100	0.050	0.200	1.115
Total Nitrogen	0.392	1.050	0.590	0.050	0.200	1.186
Ortho Phosphorus	0.127	0.060	0.036	0.002	0.008	0.322
Total Phosphorus	0.138	0.080	0.044	0.008	0.032	0.418
Chlorophyll A corrected for Pheophytin	Not Detected	4.01	2.80	0.25	1.00	7.95
Pheophytin	7.53	1.66	1.00	0.25	1.00	2.28

Minerals

	Median (mg/l)	FL Stream Median	FL Spring Median	Minimum Detection Limit	Practical Quantitation Limit	Myakka River
Chloride	11,034	.	.	0.353	1.412	.
Sodium	4,560	14.44	3.7	0.034	0.136	.
Hardness	3,623	165	174	0.882	2.728	.
Sulfate	1,702	15.6	14	0.339	1.356	.
Magnesium	566	5.5	7.1	0.006	0.024	.
Calcium	518	36	55.7	0.03	0.12	.
Potassium	187	2.1	0.6	0.189	0.676	.
Bicarbonate Alkalinity	128	.	.	0.594	2.376	.
Total Alkalinity	128	79	158	0.594	2.376	.
Strontium	31.9	.	.	1	4	.
Silica	17.7	.	.	0.044	0.176	.
Sulfide	2.840	.	.	0.028	0.112	.
Fluoride	1.090	0.150	0.110	0.030	0.120	.
Hydrogen Sulfide	0.727	.	.	0.006	0.024	.
Carbonate Alkalinity	Not Detected	.	.	0.594	2.376	.

Metals

	Median (ug/l)	FL Stream Median	FL Spring Median	Minimum Detection Limit	Practical Quantitation Limit	Myakka River
Iron	< 29	200.0	25.5	29.0	116.0	.
Arsenic	Not Detected	2.10	3.00	6.02	24.08	.
Copper	Not Detected	1.37	2.50	4.00	18	.
Lead	Not Detected	7.22	7.34	3.00	12	.
Chromium	Not Detected	1.00	0.70	2.00	8	.
Molybdenum	Not Detected	1.60	.	2.00	8	.
Selenium	Not Detected	1.00	4.00	1.57	6.28	.
Zinc	Not Detected	10.00	5.00	1.40	5.6	.
Nickel	Not Detected	1.60	1.50	1.18	4.72	.
Manganese	Not Detected	13.47	2.00	0.98	3.92	.
Cadmium	Not Detected	0.10	0.75	0.90	3.60	.
Mercury	Not Detected	0.200	.	0.198	0.792	.

Individual Results

	WMS-8	WMS-1	WMS-2	WMS-3	WMS-4	WMS-5	WMS-6	WMS-7
Sample Depth (ft)	7	15	30	45	60	75	90	130
Time	0900	0745	0753	0804	0822	0831	0842	0851
Temp C	30	30	30	30	30	30	30	30
Temp (F)	45	86	86	86	86	86	86	86
Cond	30,647	30,667	30,655	30,649	30,650	30,653	30,656	26,430

(umhos/cm)								
Cond (mmhos/cm)	30.65	30.667	30.655	30.649	30.65	30.653	30.66	26.43
Salinity (ppt)	18.9	18.9	18.9	18.9	18.9	18.9	18.9	15.9
Oxygen Sat (%)	27.3	9.5	18.2	19.7	19.4	19.1	14.8	17.1
Oxygen, Diss (mg/l)	1.6	0.7	1.2	1.4	1.3	1.3	1.0	1.2
pH		6.8	7.0	7.0	7.0	7.0	7.0	
Secchi Depth (m)		9.5						
BOD5 (mg/l)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
ChlA (ug/l)	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Pheo	8.71	7.06	7.920	8.05	7.07	7.14	6.82	8.52
COLOR PCU	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
F Coli (cfu/100ml)	< 10							
NH3 (mg/l)	0.275	0.267	0.251	0.291	0.315	0.324	0.318	0.306
NOX (mg/l)	0.013	0.010	0.009	0.011	0.008	0.008	0.008	0.010
TKN (mg/l)	0.379	0.372	0.381	0.381	0.368	0.408	0.394	0.397
TN (mg/l)	0.39	0.38	0.39	0.39	0.38	0.42	0.40	0.41
OP (mg/l)	0.13	0.118	0.150	0.146	0.15	0.097	0.11	0.124
TP (mg/l)	0.144	0.124	0.156	0.154	0.156	0.107	0.131	0.129
TSS (mg/l)	0.800	1.200	1.400	1.600	1.600	3.200	0.800	3.400
Turb (NTU)	0.40	0.42	0.40	0.48	0.41	0.39	0.47	0.55
Fe (ug/l)	< 29	58	90	< 29	< 29	< 29	< 29	< 29
Cd (ug/l)	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9
Ca (mg/l)	535	501	511	517	517	518	522	526
Cr (ug/l)	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Cu (ug/l)	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4
Mg (mg/l)	566	584	684	564	565	561	566	562
Mn (ug/l)	< 0.98	< 0.98	< 0.98	< 0.98	< 0.98	< 0.98	< 0.98	< 0.98
Mo (ug/l)	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Ni (ug/l)	< 1.18	< 1.18	< 1.18	< 1.18	< 1.18	< 1.18	< 1.18	< 1.18
K (mg/l)	185	217	230	186	188	187	172	180
Na (mg/l)	4,610	5,748	5,390	4,570	4,440	4,550	4,440	4,390
Sr (ug/l)	31,300	34,820	32,900	32,100	31,600	32,200	31,600	30,600
Zn (ug/l)	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4
Hg (ug/l)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Cl (mg/l)	11,125	11,027	10,915	10,927	11,041	11,004	11,085	11,042
F (mg/l)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
SO4 (mg/l)	1,717	1,702	1,674	1,680	1,700	1,702	1,706	1,705
Bicarb HCO3 (mg/l)	129	128	128	130	128	129	128	128
Carbonate Alkalinity	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

CO3 (mg/l)								
Alk Total (mg/l)	129	128	128	130	128	129	128	128
Hardness (mg/l)	3,658	3,656	4,082	3,605	3,609	3,595	3,626	3,619
TDS (mg/l)	19,312	19,004	19,244	19,116	19,300	19,248	19,092	19,076
As (ug/l)	< 6.02	< 6.02	< 6.02	< 6.02	< 6.02	< 6.02	< 6.02	< 6.02
Pb (ug/l)	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Se (ug/l)	< 1.57	< 1.57	< 1.57	< 1.57	< 1.57	< 1.57	< 1.57	< 1.57
H2S (mg/l)	0.92	0.59	0.70	0.62	0.64	0.76	0.76	0.88
Sulfide (mg/l)	3.13	2.70	2.86	2.88	2.76	2.77	2.82	3.16
Si (mg/l)	17.3	17.1	18.3	17.7	17.6	16.3	17.8	18.2
TOC (mg/l)	1.95	2.28	1.76	2.89	3.11	2.22	2.62	1.82
Enterococci	< 10							

Acknowledgements:
Thanks to Jennifer Graham and others of Warm Mineral Springs Spa for their assistance.

References:

The Underwater Archeological Resources of Tampa Bay, Stephen J. Gluckman, University of South Florida Department of Anthropology.

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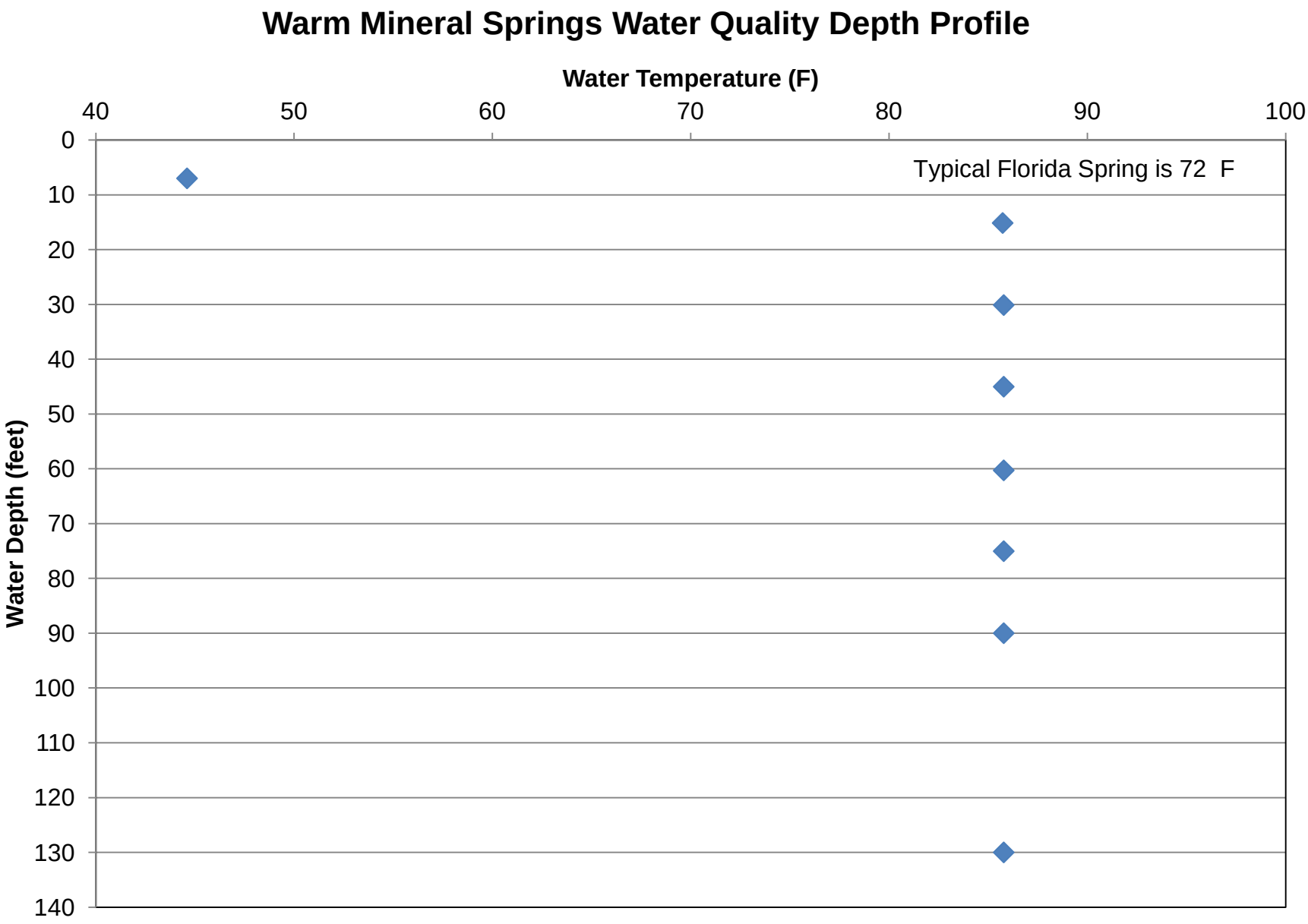
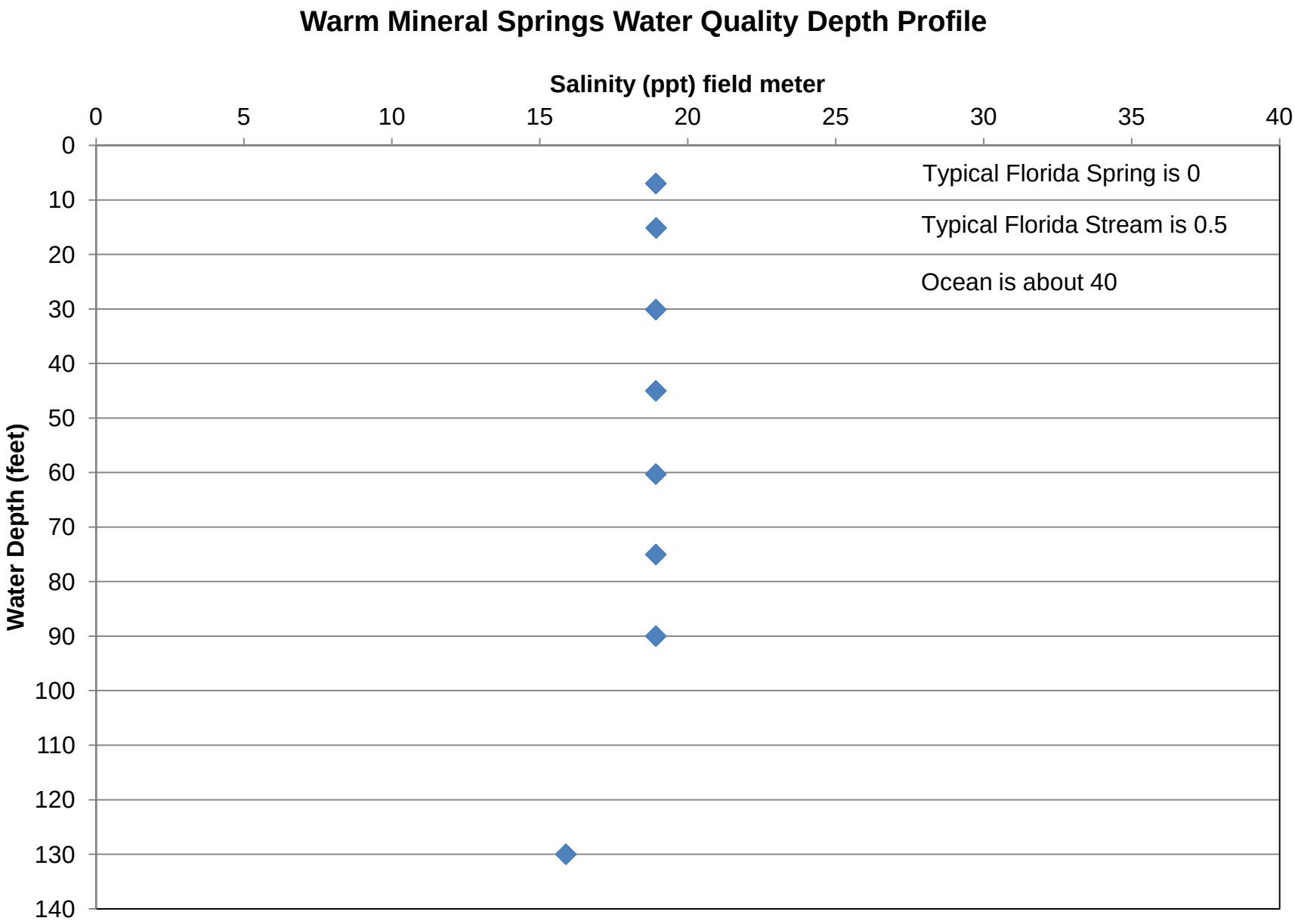
The Geology of Warm Mineral Springs, Sarasota County Florida, Frank R. Rupert, Florida Geological Survey, 1994.

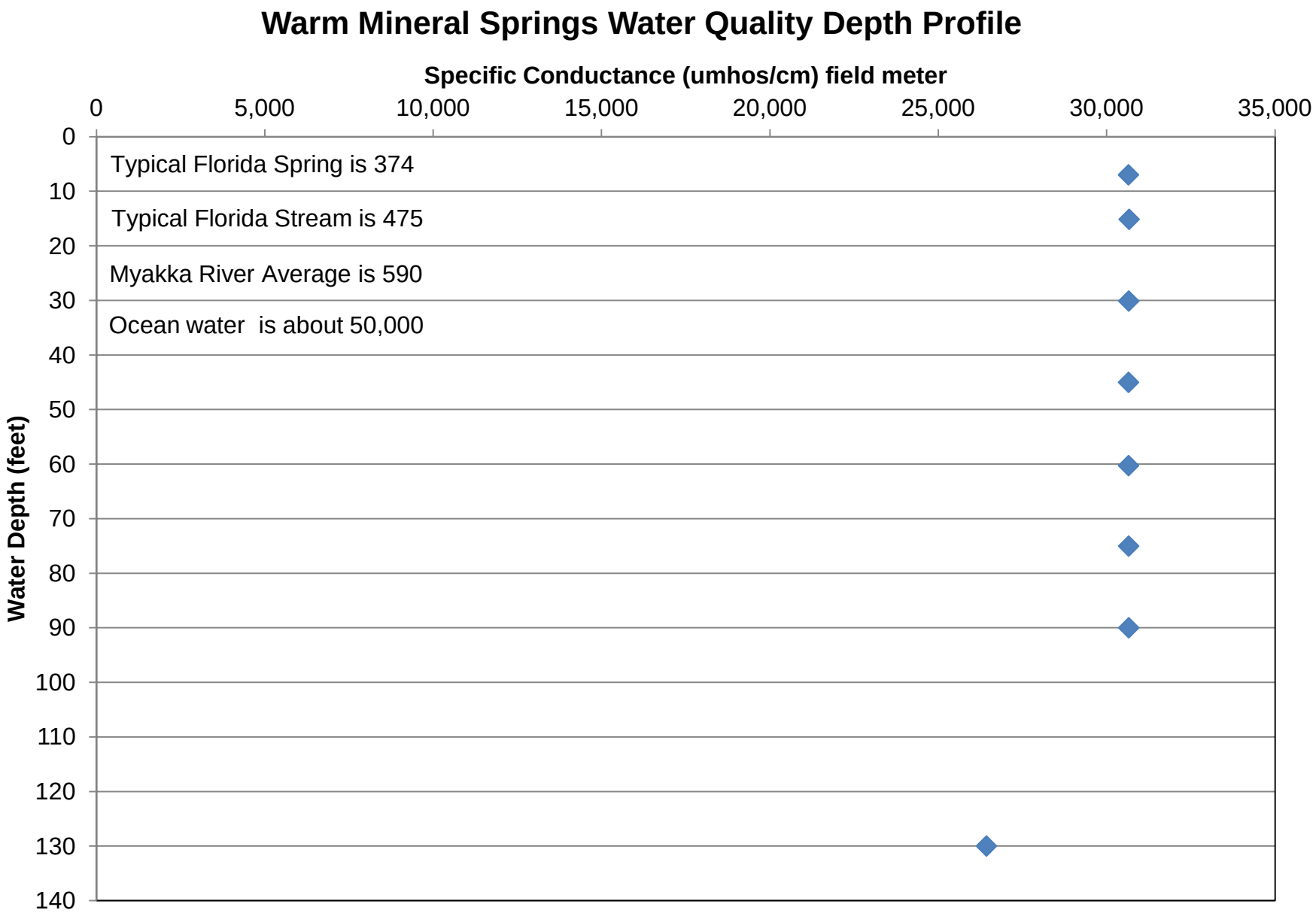
Springs of Florida, Bulletin No. 66, Florida Geological Survey, Scott, et. al., 2004

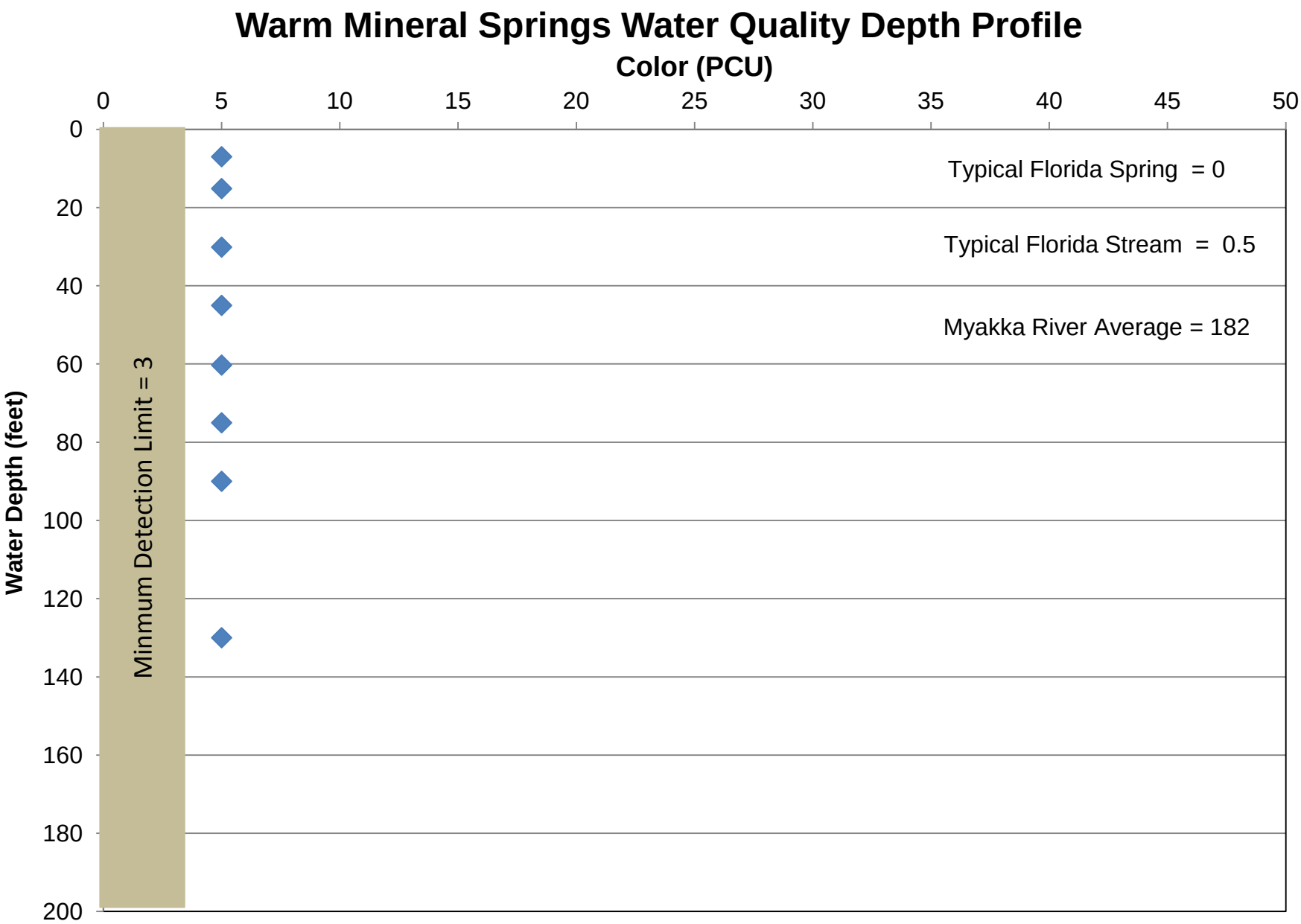
Typical Water Quality Values for Florida's Lakes, Streams and Estuaries, Mark Friedemann and Joe Hand, Standards and Monitoring Section, Bureau of Surface Water Management, State of Florida, 1989.

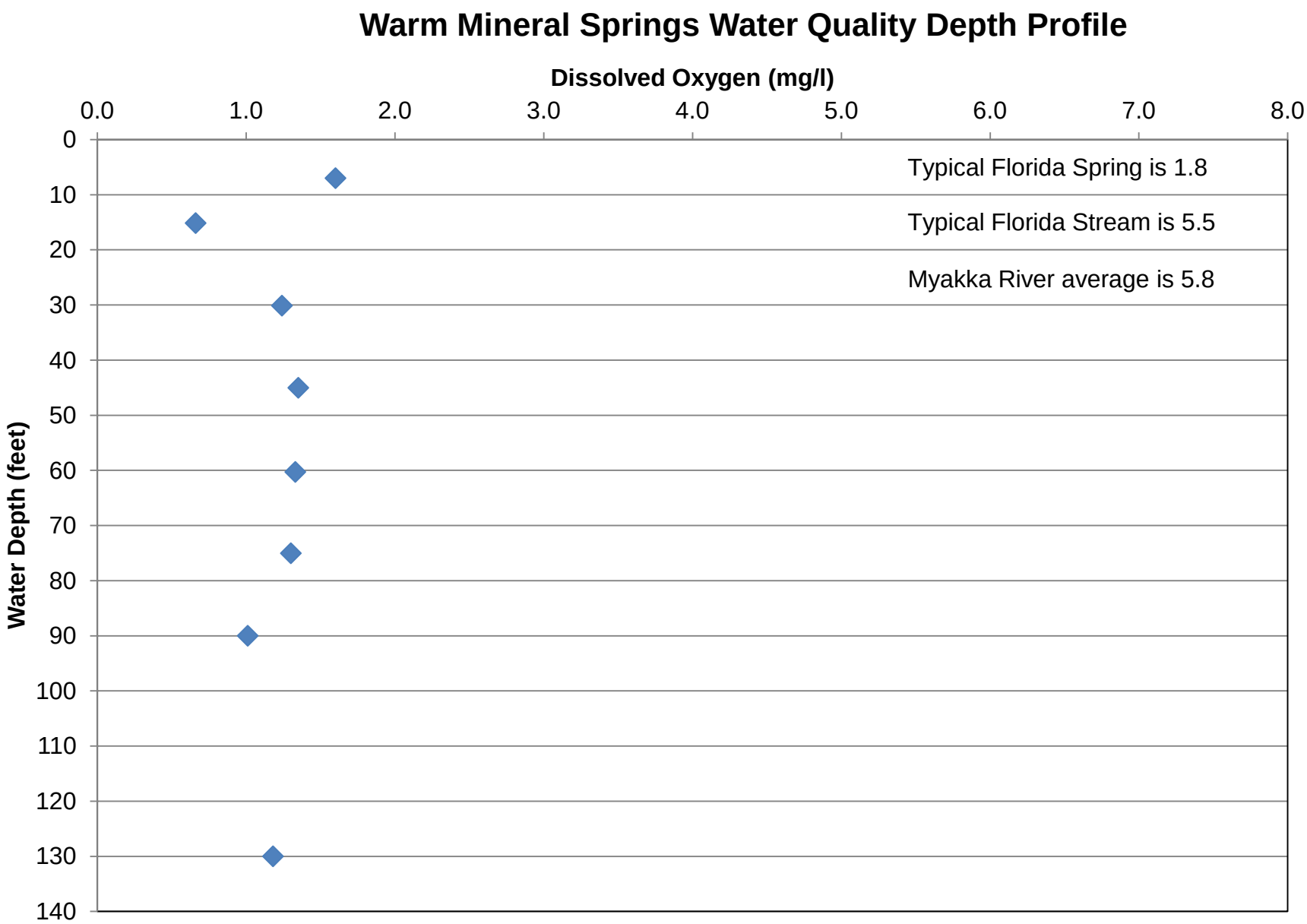
Warm Mineral Springs Sampling by Sarasota County
September 2011
Water Quality Depth Profiles

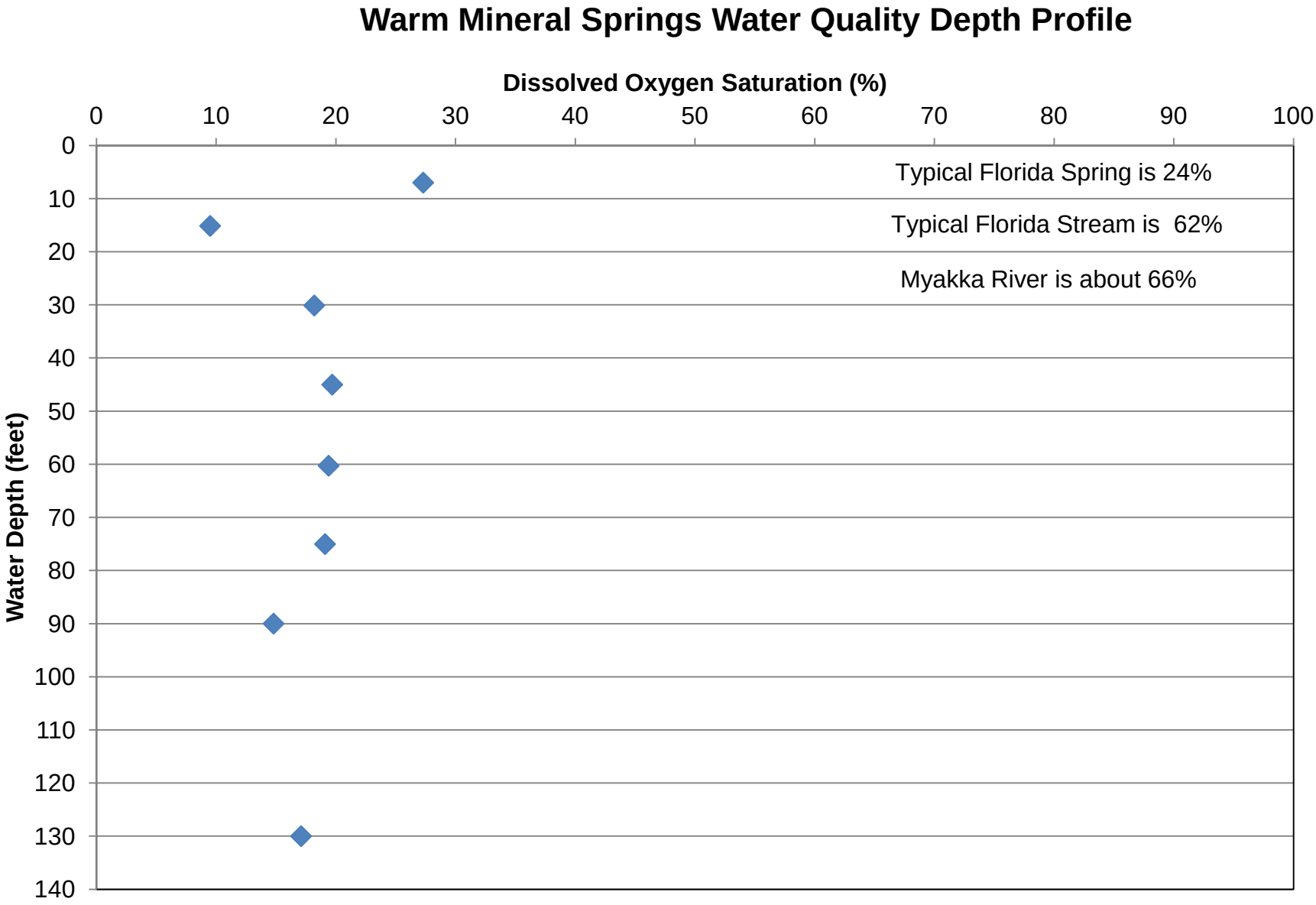

Warm Mineral Springs Water Quality Depth Profile
Water Temperature (F)
40
50
60
70
80
90
100
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Typical Florida Spring is 72 F


Warm Mineral Springs Water Quality Depth Profile
Salinity (ppt) field meter
0
5
10
15
20
25
30
35
40
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Typical Florida Spring is 0
Typical Florida Stream is 0.5
Ocean is about 40

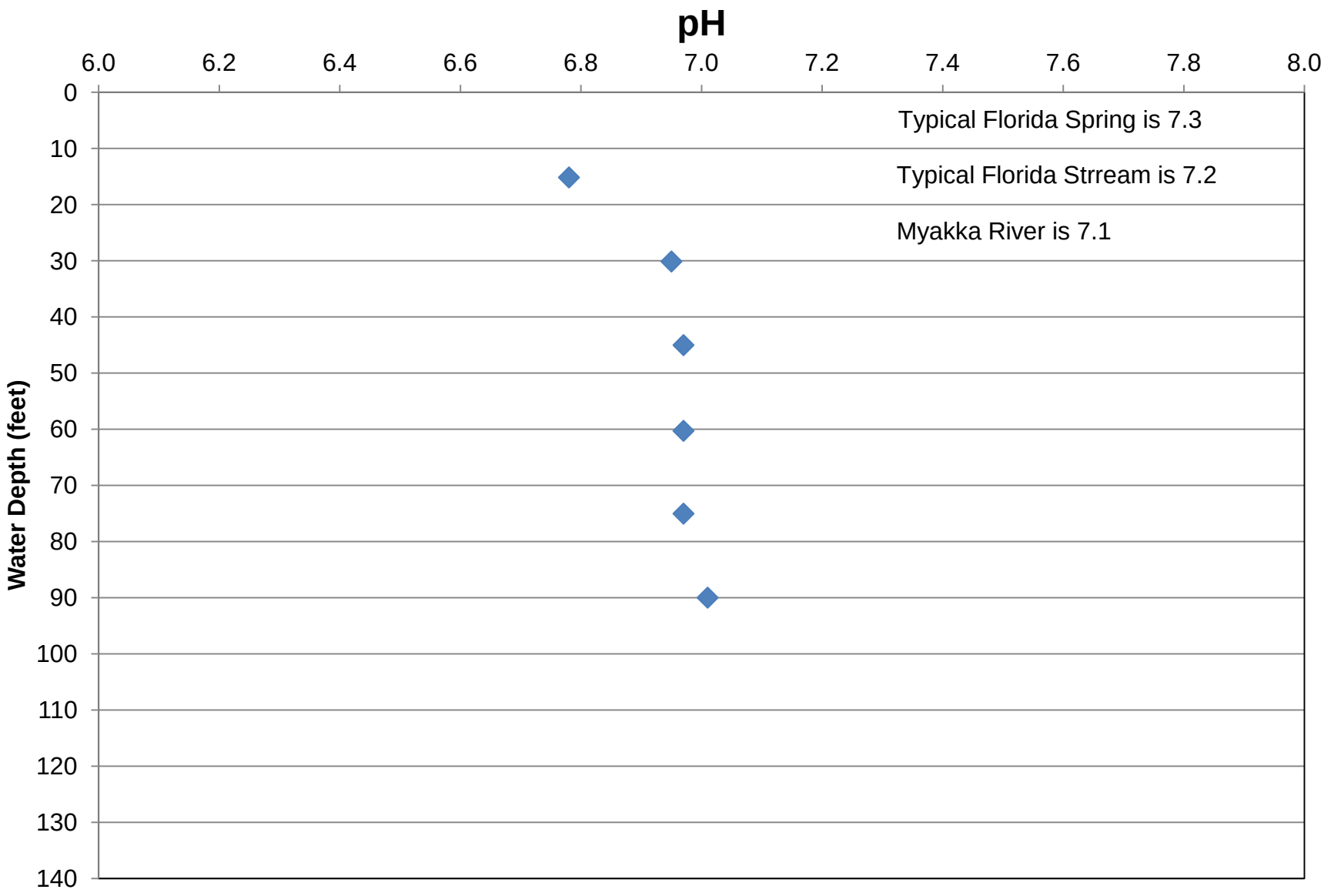

Warm Mineral Springs Water Quality Depth Profile
Specific Conductance (umhos/cm) field meter
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Typical Florida Spring is 374
Typical Florida Stream is 475
Myakka River Average is 590
Ocean water is about 50,000

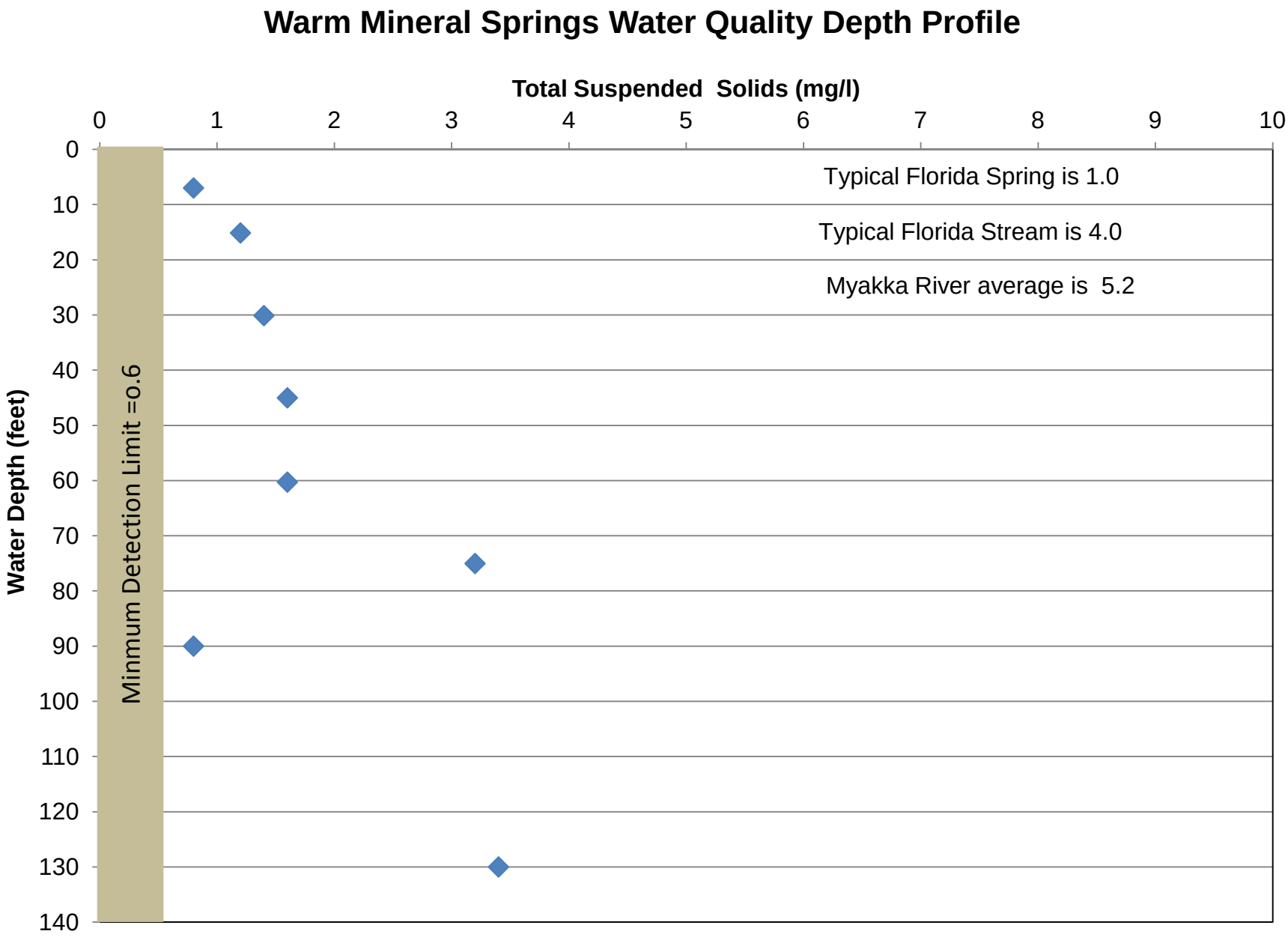

Warm Mineral Springs Water Quality Depth Profile
Color (PCU)
0
5
10
15
20
25
30
35
40
45
50
Water Depth (feet)
0
20
40
60
80
100
120
140
160
180
200
Minmum Detection Limit = 3
Typical Florida Spring = 0
Typical Florida Stream = 0.5
Myakka River Average = 182

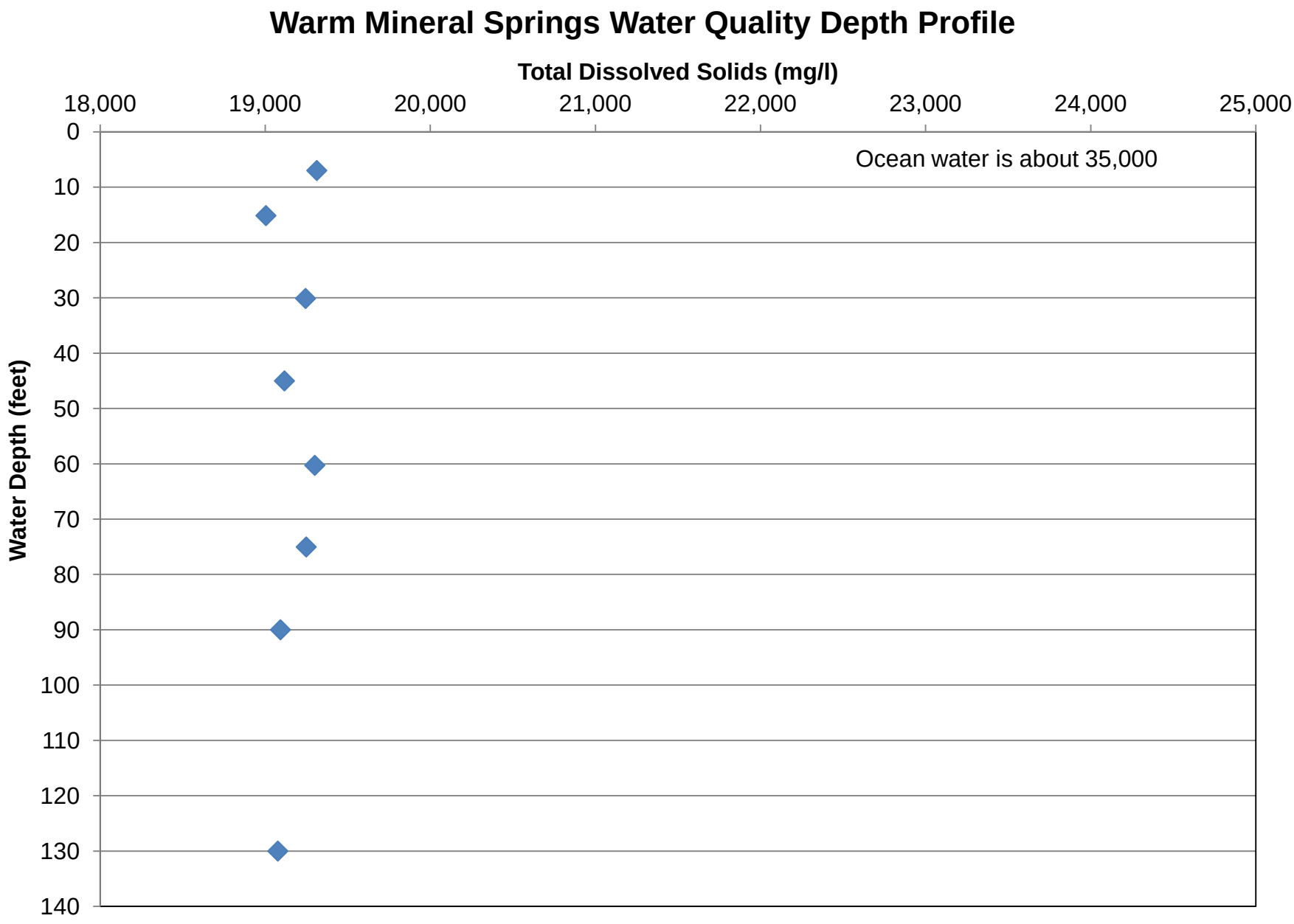

Warm Mineral Springs Water Quality Depth Profile
Dissolved Oxygen (mg/l)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Typical Florida Spring is 1.8
Typical Florida Stream is 5.5
Myakka River average is 5.8


Warm Mineral Springs Water Quality Depth Profile
Dissolved Oxygen Saturation (%)
0
10
20
30
40
50
60
70
80
90
100
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Typical Florida Spring is 24%
Typical Florida Stream is 62%
Myakka River is about 66%

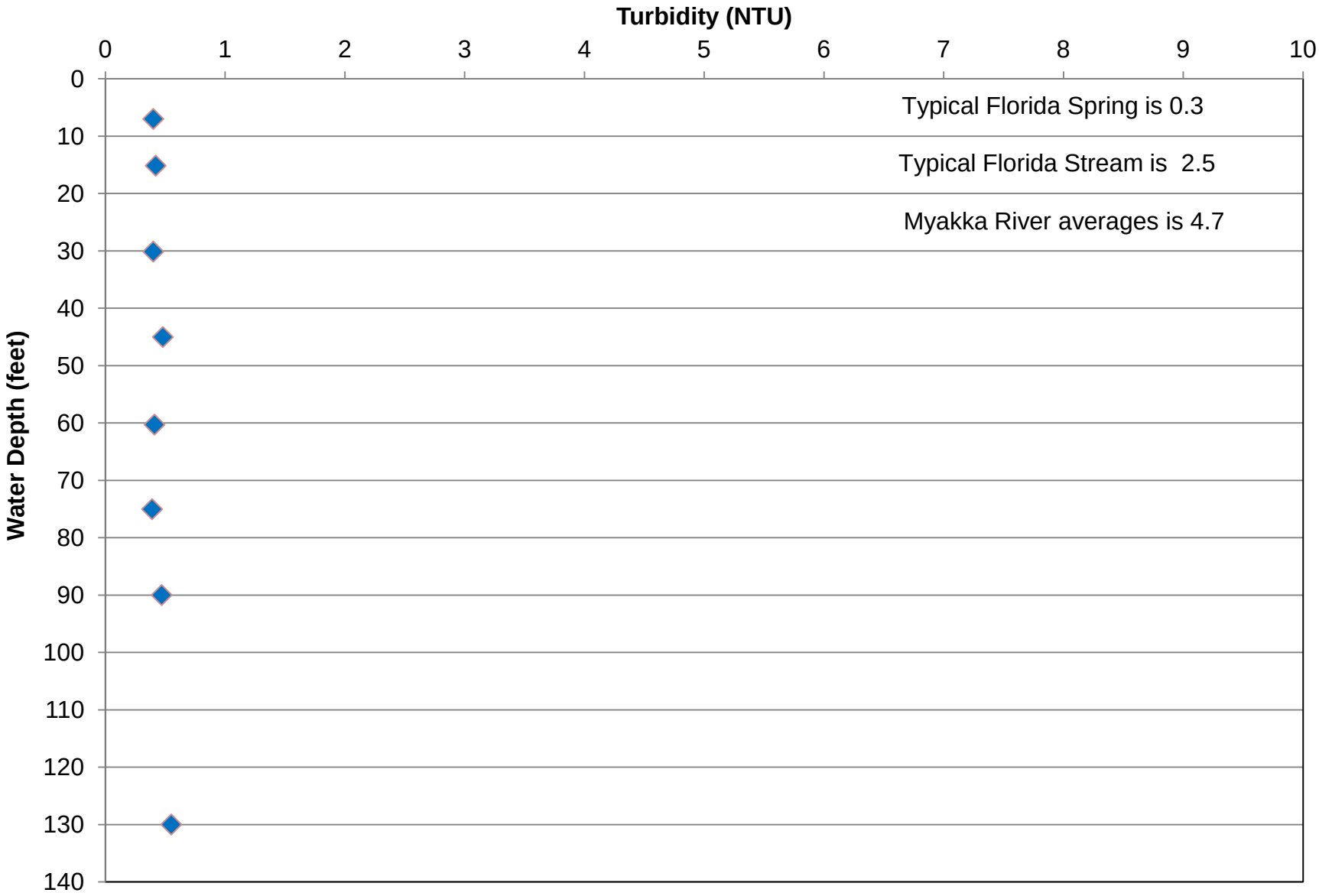
Warm Mineral Springs Water Quality Depth Profile

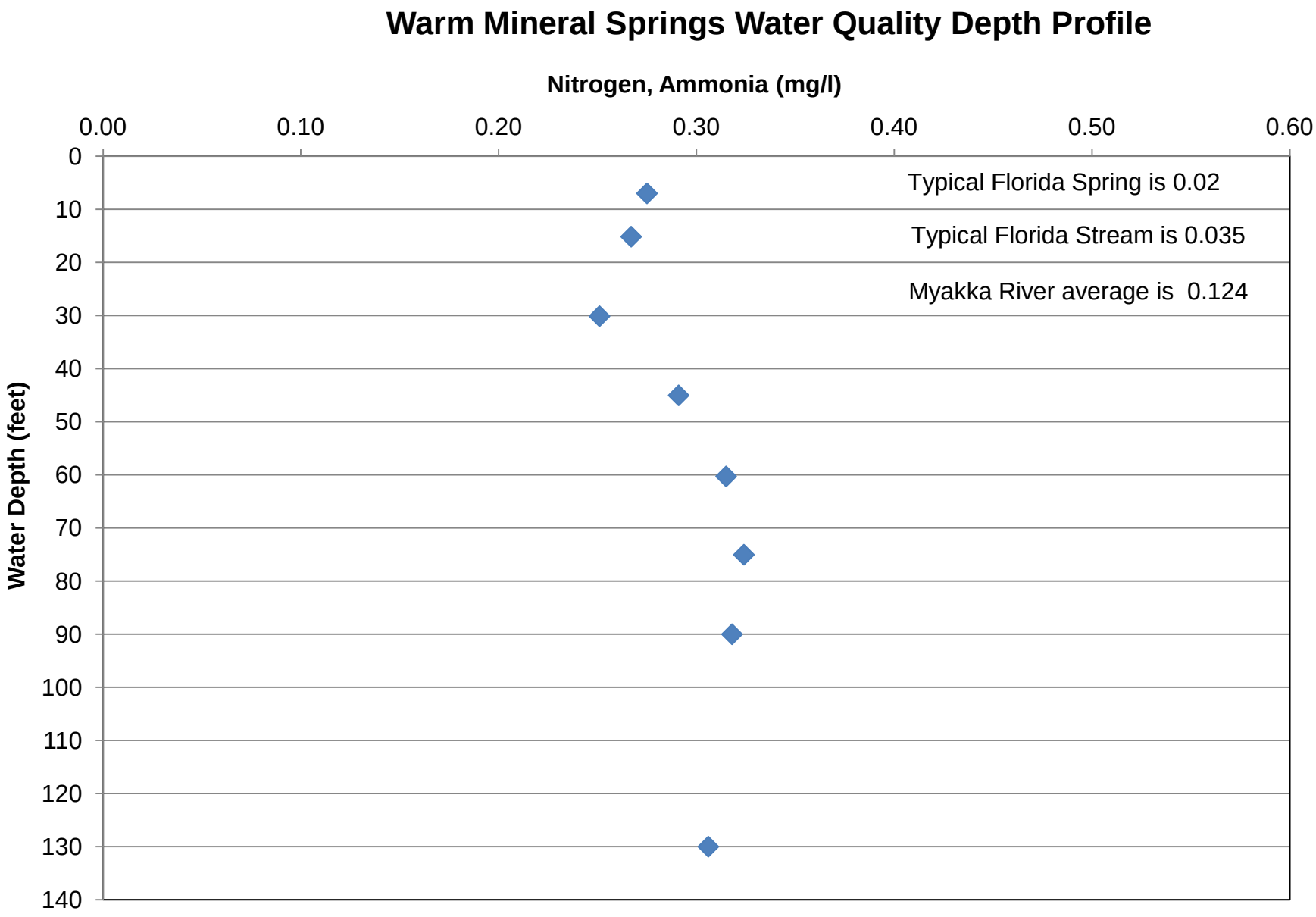



Warm Mineral Springs Water Quality Depth Profile
Total Suspended Solids (mg/l)
0
1
2
3
4
5
6
7
8
9
10
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Minmum Detection Limit =o.6
Typical Florida Spring is 1.0
Typical Florida Stream is 4.0
Myakka River average is 5.2

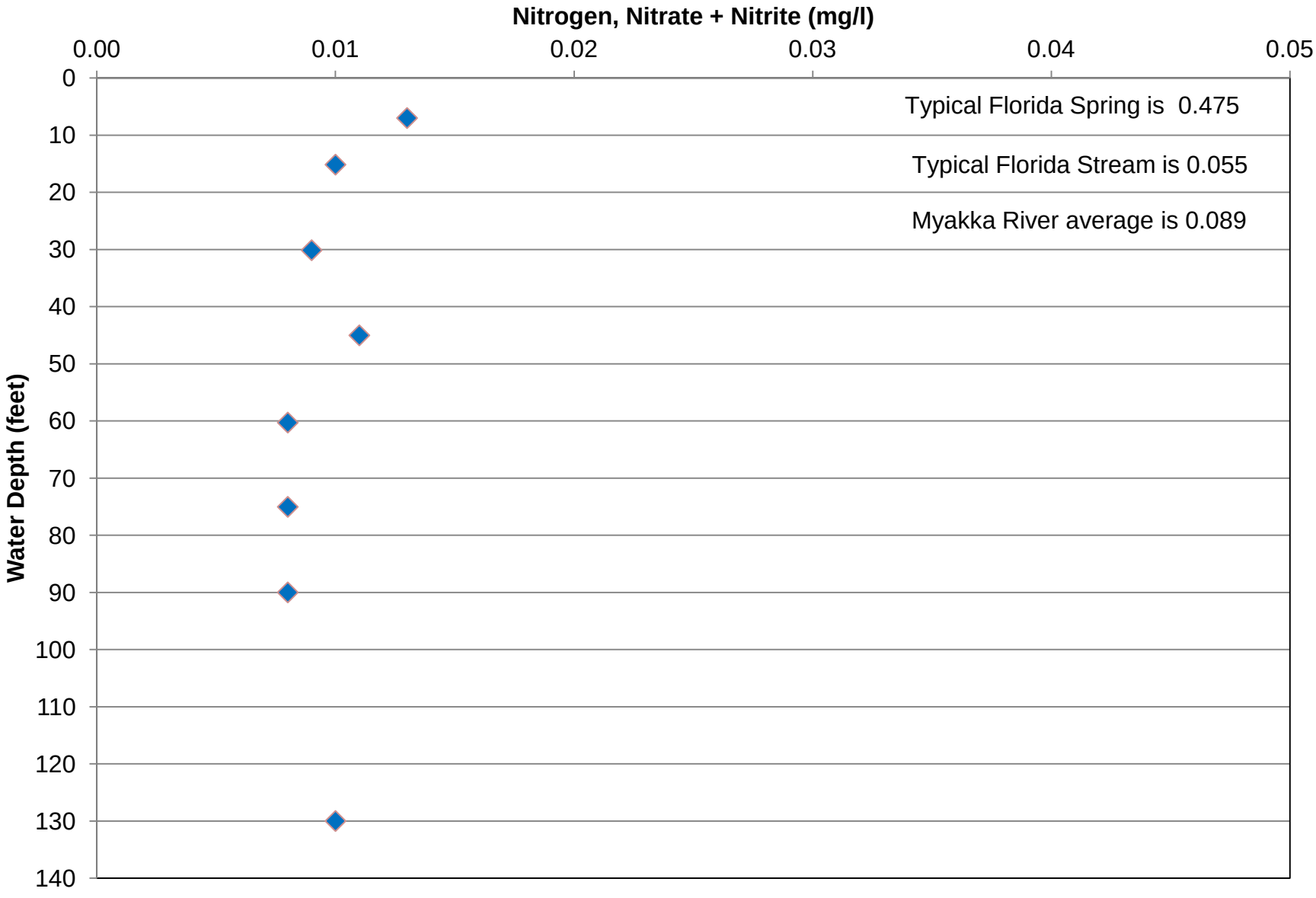

Warm Mineral Springs Water Quality Depth Profile
Total Dissolved Solids (mg/l)
18,000
19,000
20,000
21,000
22,000
23,000
24,000
25,000
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Ocean water is about 35,000

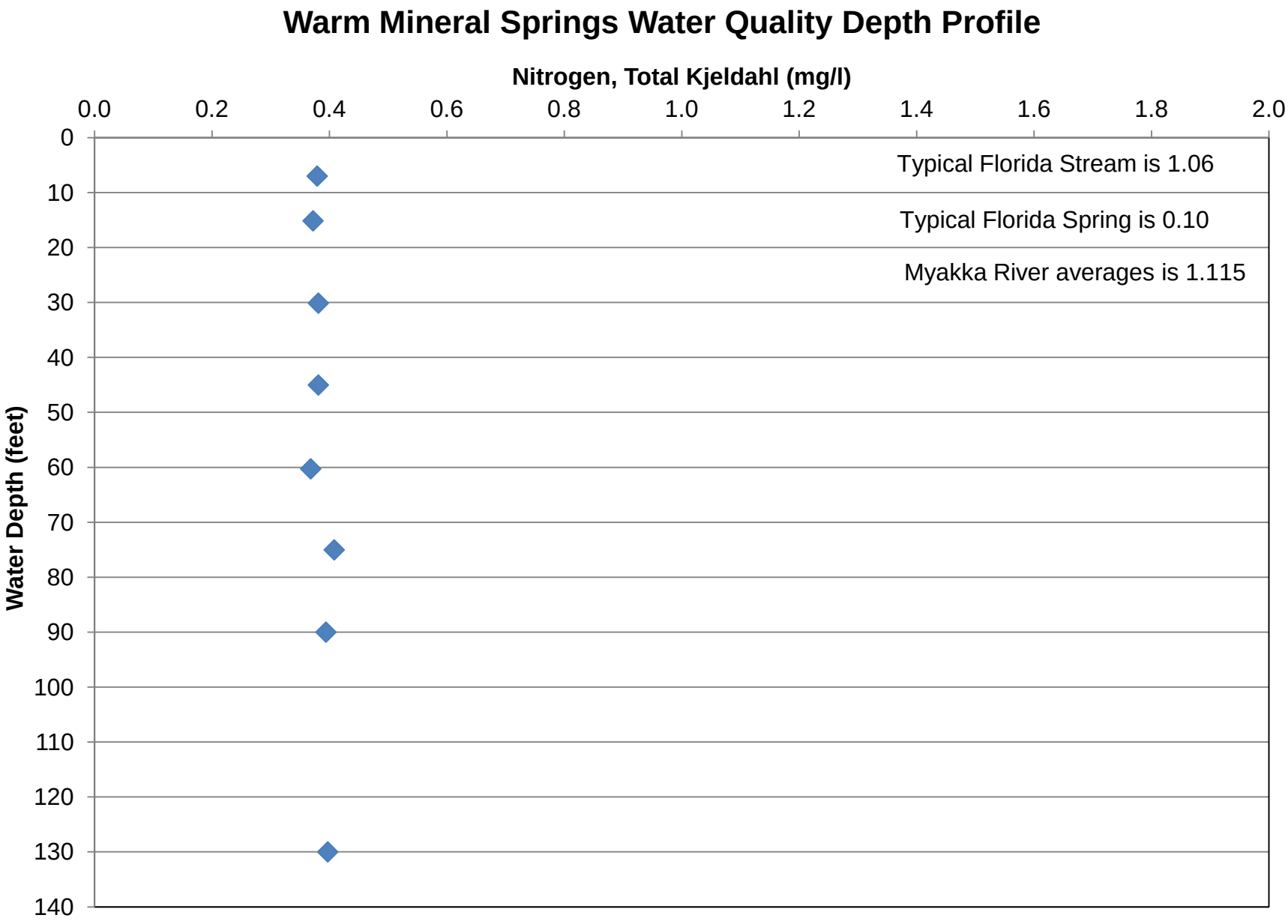
Warm Mineral Springs Water Quality Depth Profile

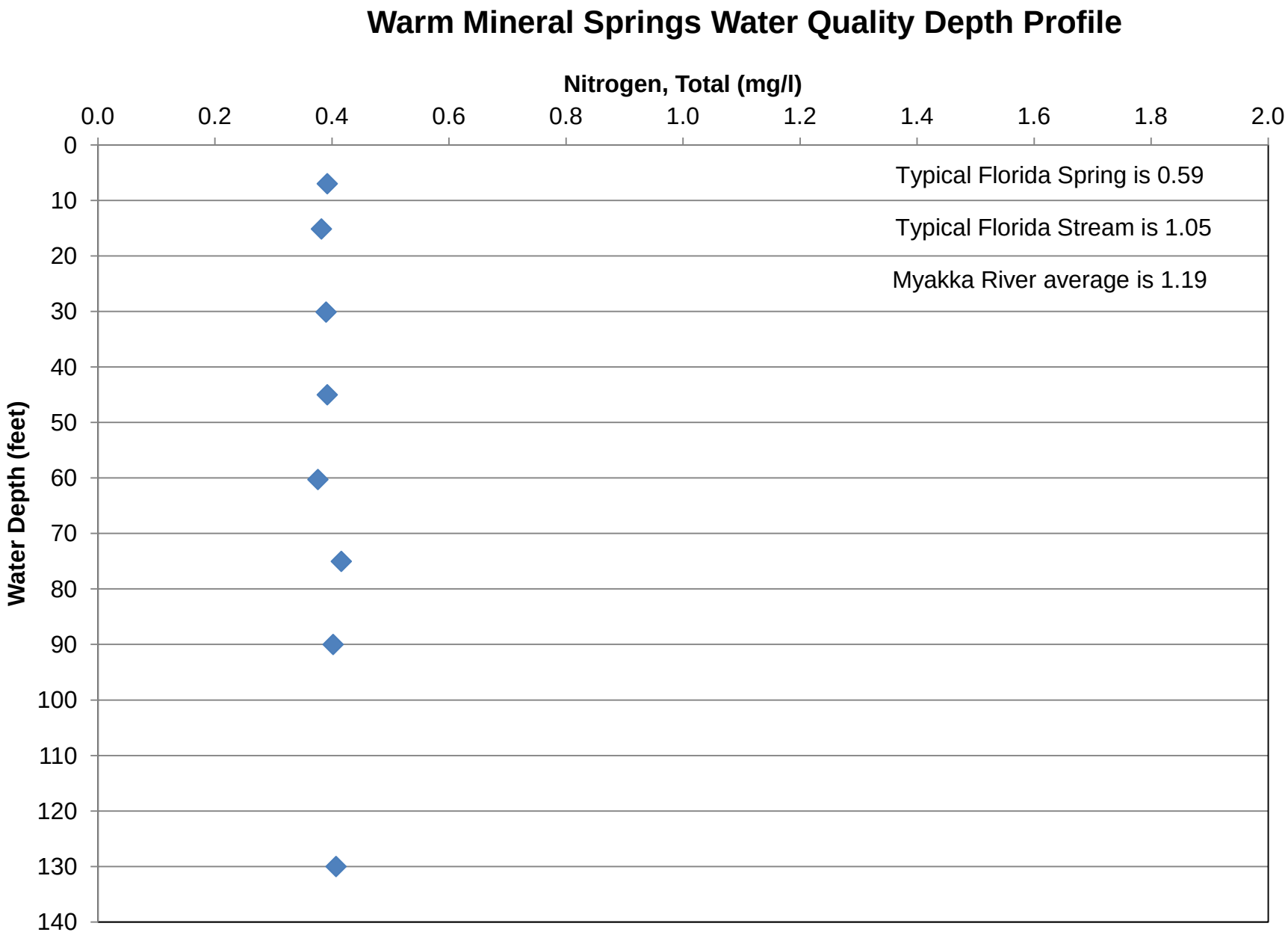


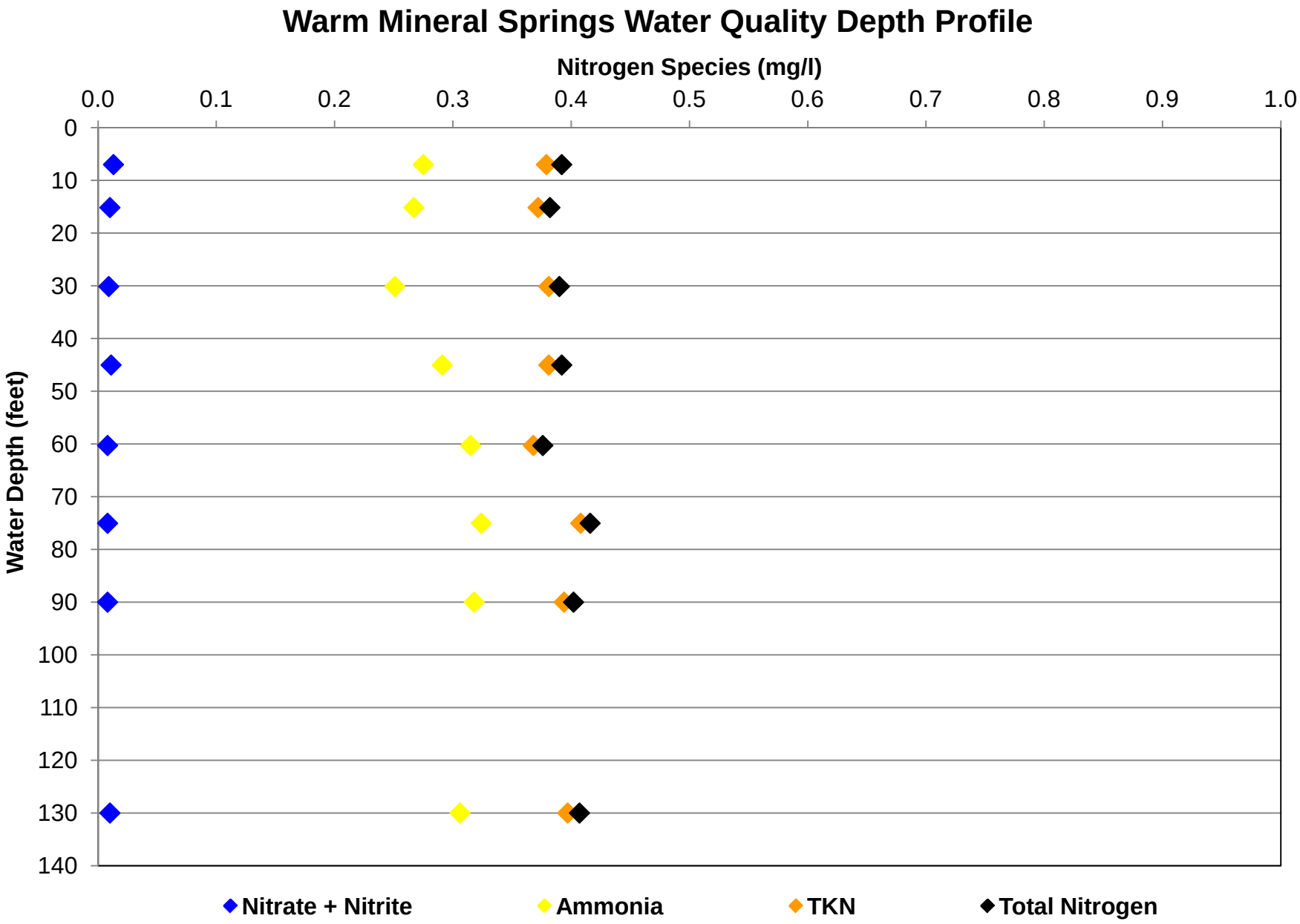

Warm Mineral Springs Water Quality Depth Profile
Nitrogen, Ammonia (mg/l)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Typical Florida Spring is 0.02
Typical Florida Stream is 0.035
Myakka River average is 0.124

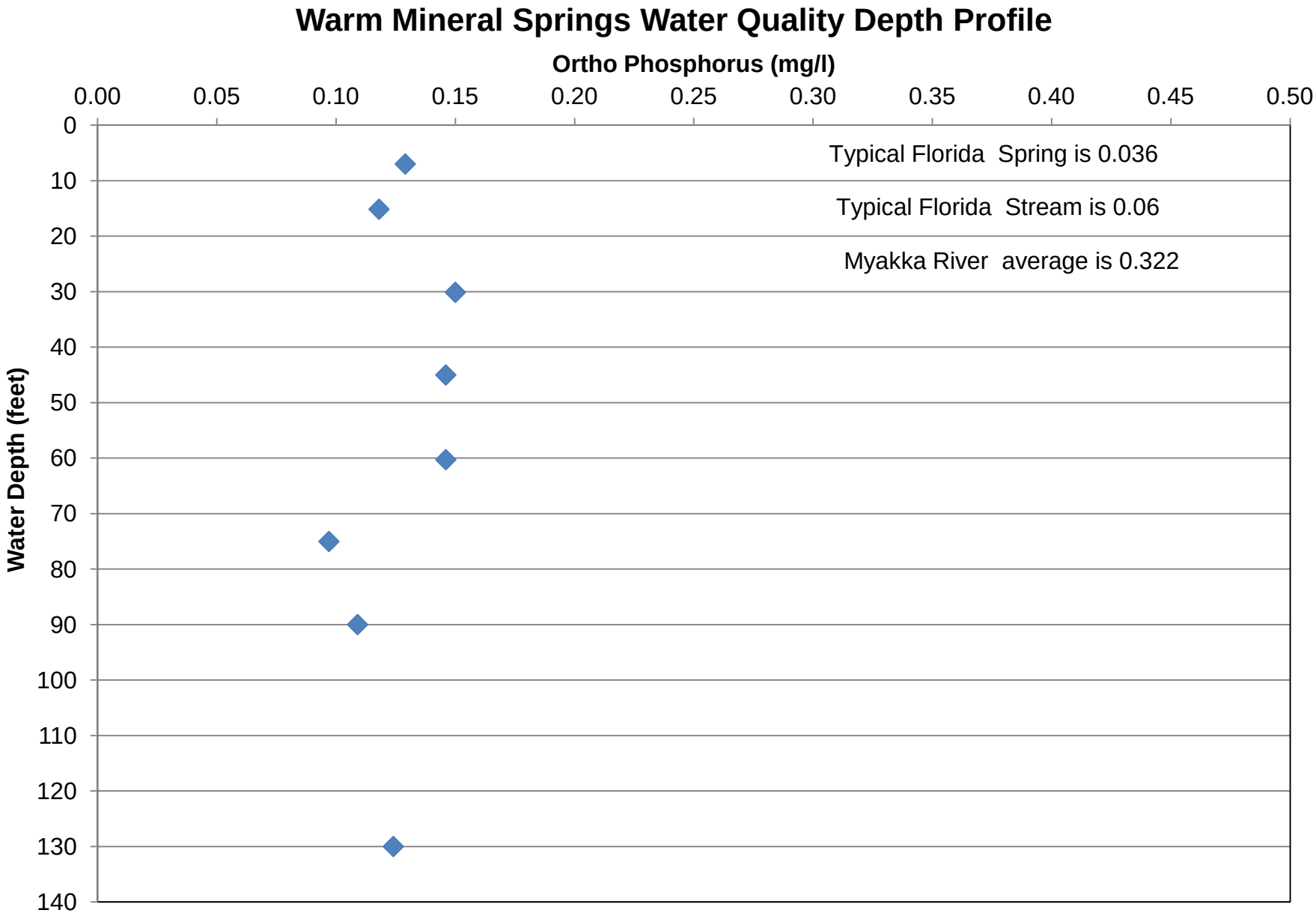
Warm Mineral Springs Water Quality Depth Profile

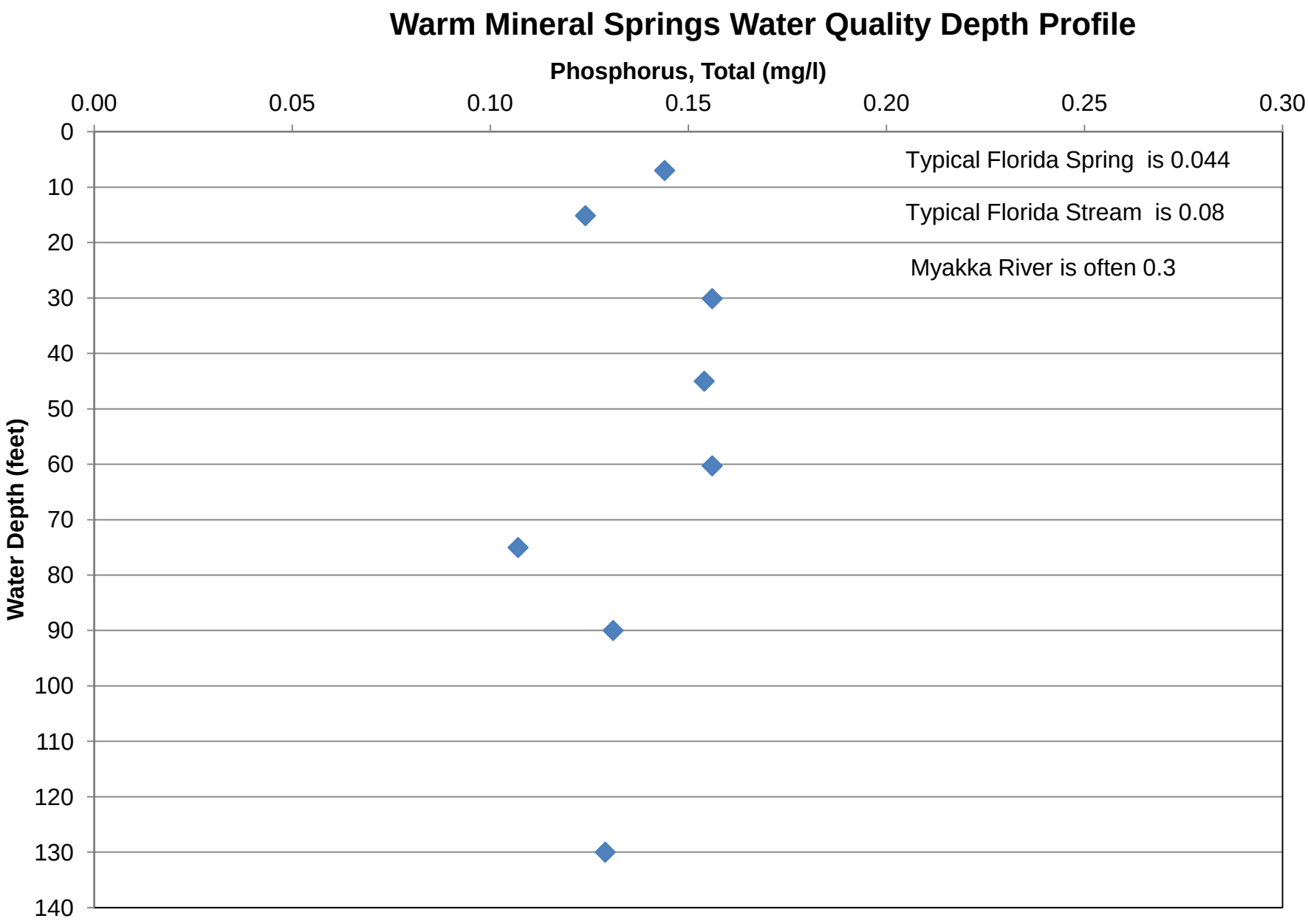


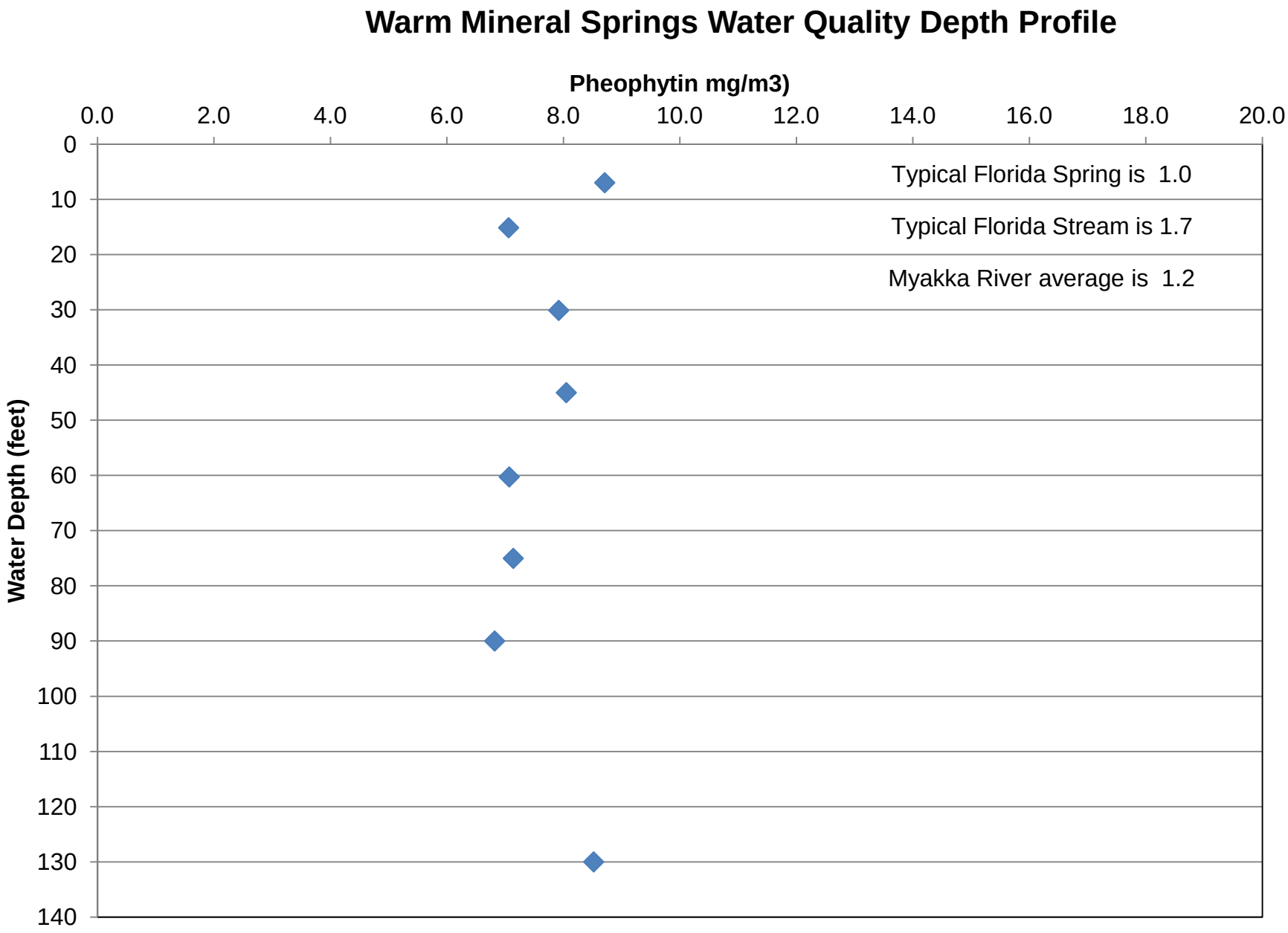

Warm Mineral Springs Water Quality Depth Profile
Nitrogen, Total Kjeldahl (mg/l)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Typical Florida Stream is 1.06
Typical Florida Spring is 0.10
Myakka River averages is 1.115

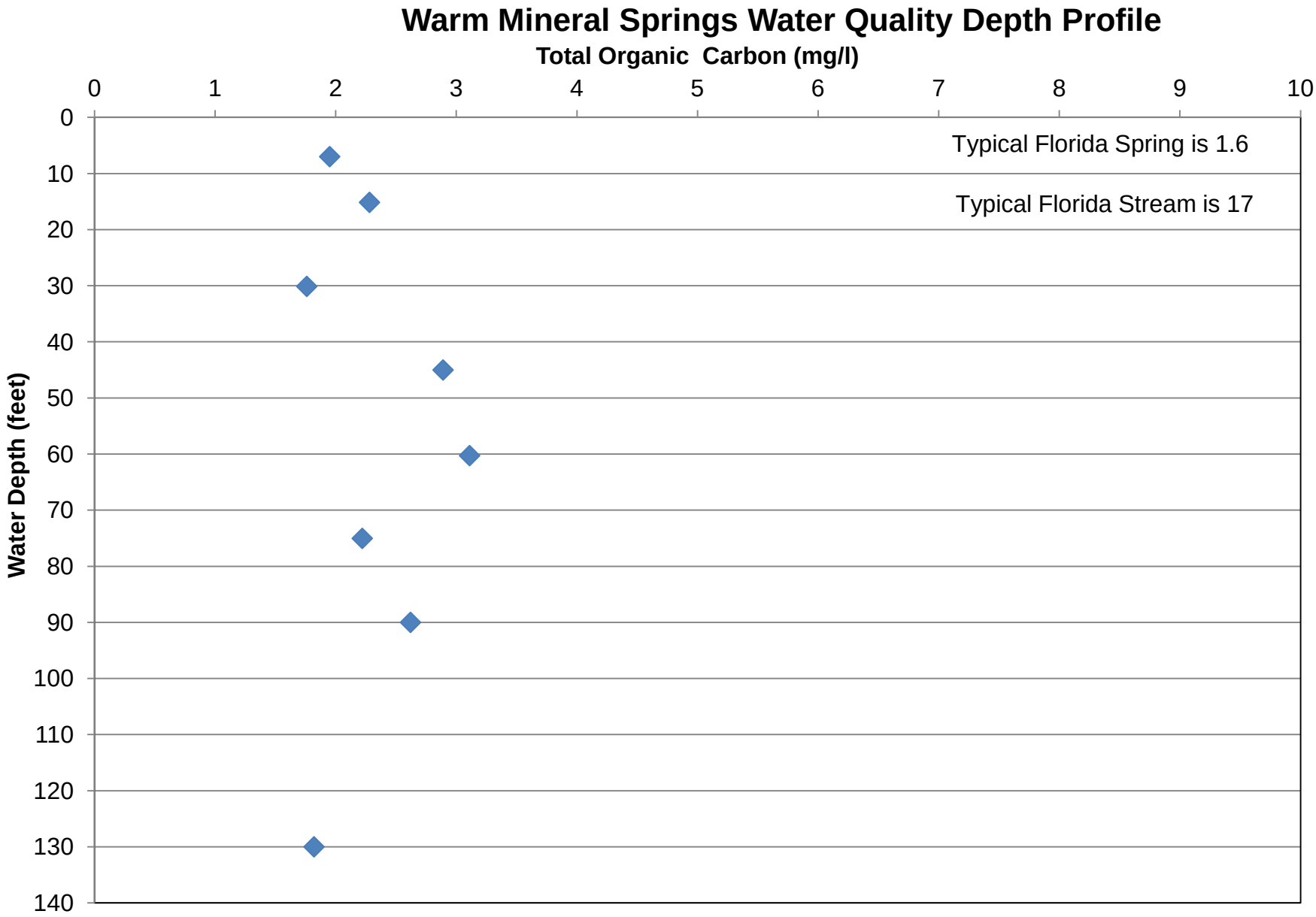

Warm Mineral Springs Water Quality Depth Profile
Nitrogen, Total (mg/l)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Typical Florida Spring is 0.59
Typical Florida Stream is 1.05
Myakka River average is 1.19

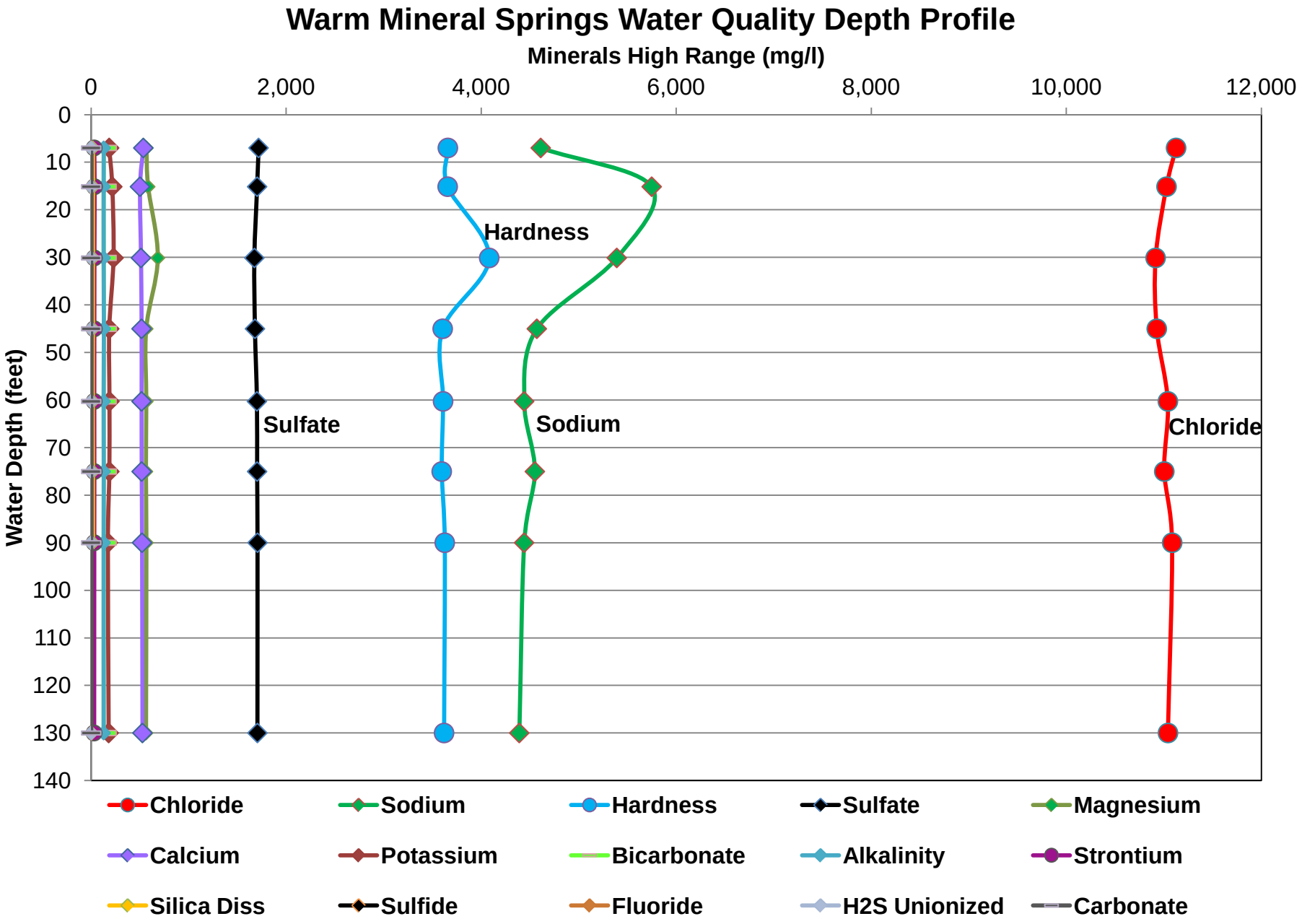

Warm Mineral Springs Water Quality Depth Profile
Nitrogen Species (mg/l)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Nitrate + Nitrite
Ammonia
TKN
Total Nitrogen

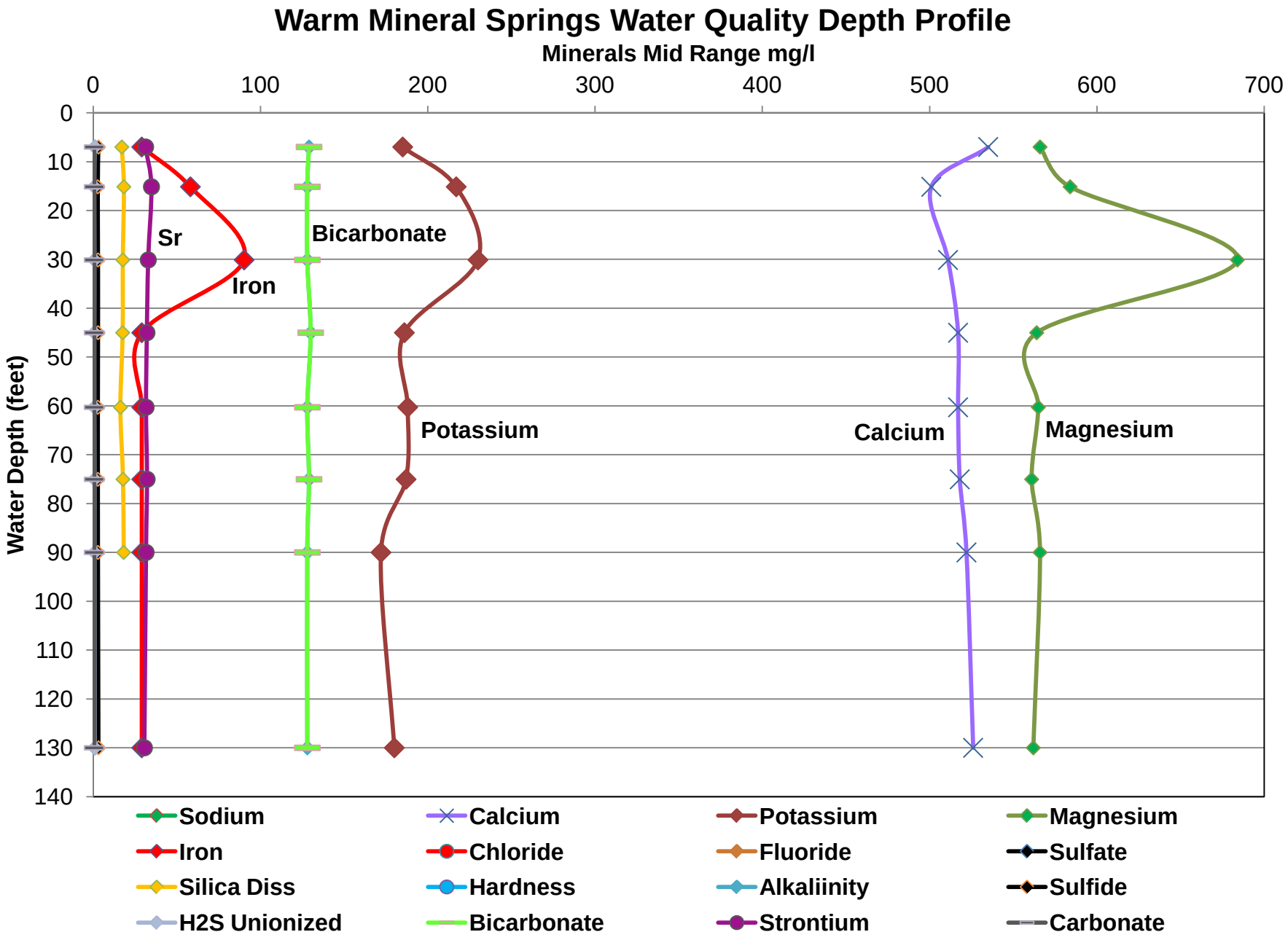

Warm Mineral Springs Water Quality Depth Profile
Ortho Phosphorus (mg/l)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Typical Florida Spring is 0.036
Typical Florida Stream is 0.06
Myakka River average is 0.322

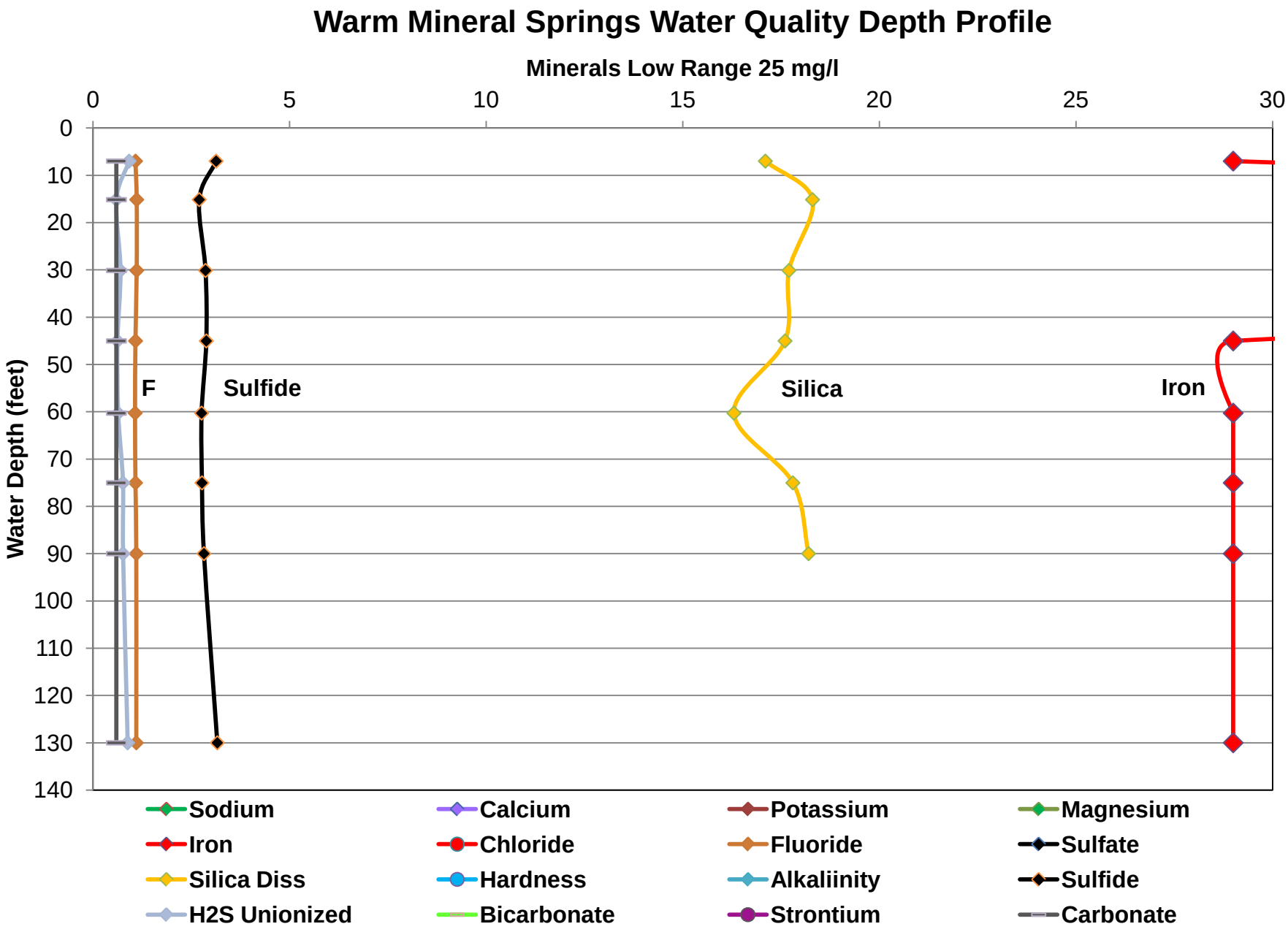

Warm Mineral Springs Water Quality Depth Profile
Phosphorus, Total (mg/l)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Typical Florida Spring is 0.044
Typical Florida Stream is 0.08
Myakka River is often 0.3

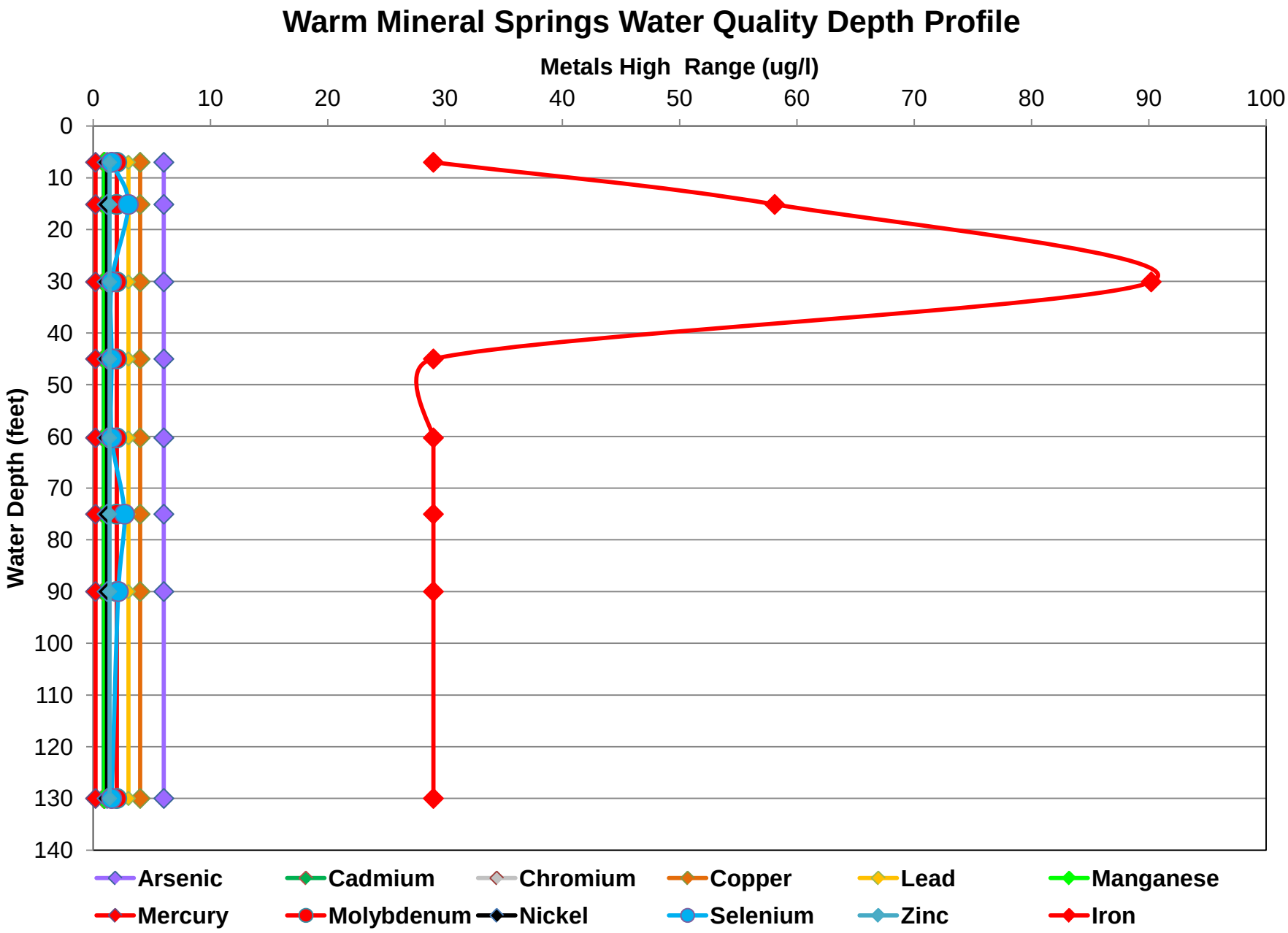

Warm Mineral Springs Water Quality Depth Profile
Pheophytin mg/m3)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Typical Florida Spring is 1.0
Typical Florida Stream is 1.7
Myakka River average is 1.2

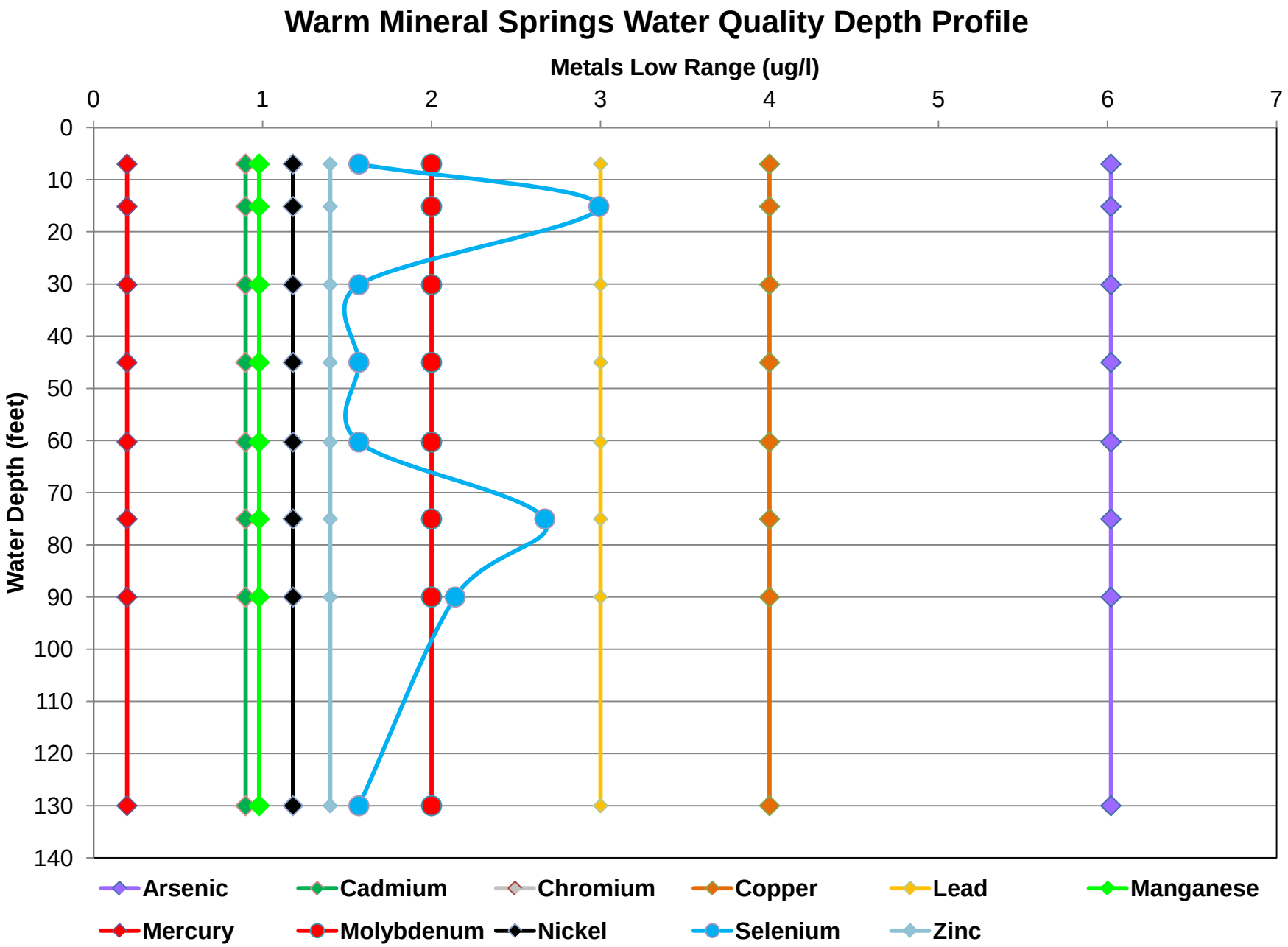

Warm Mineral Springs Water Quality Depth Profile
Total Organic Carbon (mg/l)
0
1
2
3
4
5
6
7
8
9
10
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Typical Florida Spring is 1.6
Typical Florida Stream is 17

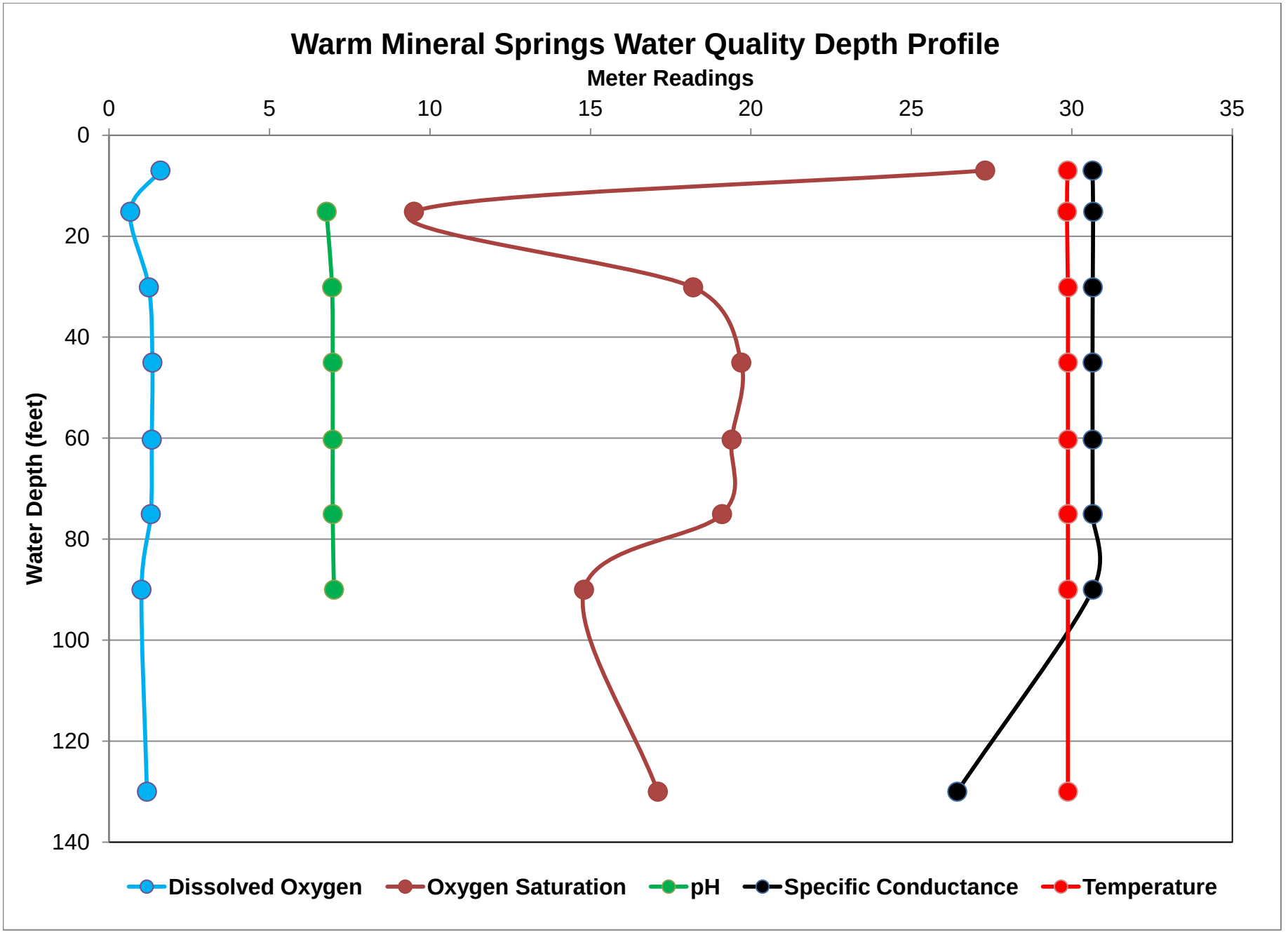

Warm Mineral Springs Water Quality Depth Profile
Minerals High Range (mg/l)
0
2,000
4,000
6,000
8,000
10,000
12,000
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Hardness
Sulfate
Sodium
Chloride
Chloride
Sodium
Hardness
Sulfate
Magnesium
Calcium
Potassium
Bicarbonate
Alkalinity
Strontium
Silica Diss
Sulfide
Fluoride
H2S Unionized
Carbonate


Warm Mineral Springs Water Quality Depth Profile
Minerals Mid Range mg/l
0
100
200
300
400
500
600
700
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Sr
Iron
Bicarbonate
Potassium
Calcium
Magnesium
Sodium
Calcium
Potassium
Magnesium
Iron
Chloride
Fluoride
Sulfate
Silica Diss
Hardness
Alkaliinity
Sulfide
H2S Unionized
Bicarbonate
Strontium
Carbonate


Warm Mineral Springs Water Quality Depth Profile
Minerals Low Range 25 mg/l
0
5
10
15
20
25
30
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
F
Sulfide
Silica
Iron
Sodium
Calcium
Potassium
Magnesium
Iron
Chloride
Fluoride
Sulfate
Silica Diss
Hardness
Alkaliinity
Sulfide
H2S Unionized
Bicarbonate
Strontium
Carbonate


Warm Mineral Springs Water Quality Depth Profile
Metals High Range (ug/l)
0
10
20
30
40
50
60
70
80
90
100
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Arsenic
Cadmium
Chromium
Copper
Lead
Manganese
Mercury
Molybdenum
Nickel
Selenium
Zinc
Iron


Warm Mineral Springs Water Quality Depth Profile
Metals Low Range (ug/l)
0
1
2
3
4
5
6
7
Water Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Arsenic
Cadmium
Chromium
Copper
Lead
Manganese
Mercury
Molybdenum
Nickel
Selenium
Zinc


Warm Mineral Springs Water Quality Depth Profile
Meter Readings
0
5
10
15
20
25
30
35
Water Depth (feet)
0
20
40
60
80
100
120
140
Dissolved Oxygen
Oxygen Saturation
pH
Specific Conductance
Temperature