

# A Comparison of Fluorinated HDPE Bottles to Teflon® and Glass Bottles for Monomethyl Mercury (MMHg) Water Sample Storage

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The aim of this study is to show that fluorinated high-density polyethylene (FLPE) bottles possess similar sample containment properties as fluoropolymer (e.g. Teflon®) and glass bottles. FLPE bottles are high-density polyethylene bottles coated inside and out with fluoropolymer for improved barrier properties and reduced absorption and permeation.

## Comparison of Properties of Bottle Types

	Durable	Inexpensive	Requires minimum cleaning	Disposable
FLPE	X	X	X	X
Glass		X	X	X
Teflon®	X			

EPA Draft Method 1630 for monomethyl mercury (MMHg) determination specifies that fluoropolymer or borosilicate glass bottles must be used for storage of water samples. Both of these bottle types have potential drawbacks. Teflon® bottles are relatively expensive and require acid-cleaning before use. Although Teflon® bottles may be reused, intensive cleaning is required between samples to prevent possible carryover contamination. Glass bottles are less expensive but are extremely fragile and can break during shipment from the collection site to the laboratory. An alternative to these bottle types that is both less expensive and durable is the use of FLPE bottles.

## Table 2. Outline of Bottle Study

Time	Blanks			Spiked Saltwater			Spiked Freshwater			Contamination Study		
	FLPE	Glass	Teflon®	FLPE	Glass	Teflon®	FLPE	Glass	Teflon®	FLPE	Glass	Teflon®
Day 0	3	3	3	3	3	3	3	3	3	1	1	1
Week 1	3	3	3	3	3	3	3	3	3	1	1	1
Week 2	3	3	3	3	3	3	3	3	3	1	1	1
Week 4	3	3	3	3	3	3	3	3	3	1	1	1
Week 9	3	3	3	3	3	3	3	3	3	1	1	1
Week 12	3	3	3	3	3	3	3	3	3	1	1	1
Week 16	3	3	3	3	3	3	3	3	3	1	1	1
Week 20	3	3	3	3	3	3	3	3	3	1	1	1
Total	24	24	24	24	24	24	24	24	24	8	8	8

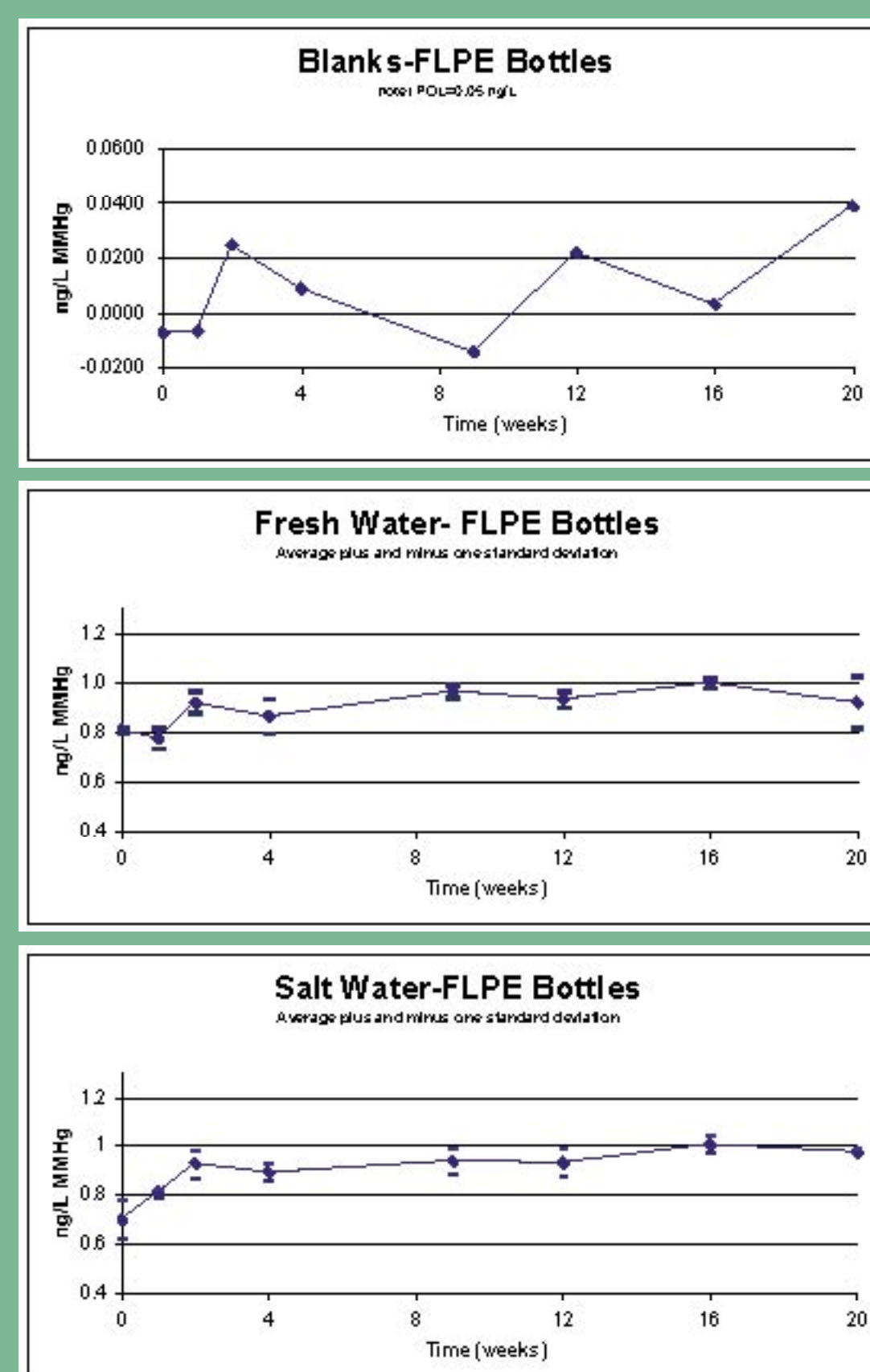
There are four major components to the bottle study.

1. Blanks-Deionized water preserved to 0.4% HCl.
2. Freshwater-Water collected from a local lake, filtered, and preserved to 0.4% HCl. It was then spiked to approximately 1 ng/L with monomethyl mercury standard.
3. Saltwater-Water collected from Puget Sound, filtered, and preserved to 0.2% H<sub>2</sub>SO<sub>4</sub>. It was then spiked to approximately 1 ng/L with monomethyl mercury standard.
4. Contamination-Deionized water preserved to 0.4% HCl and stored in an unregulated area near high concentrations of monomethyl mercury.

Three bottles of each bottle type were analyzed at each time point except for the contamination study. Only one bottle of each type was analyzed at each time point for the contamination portion of the study.

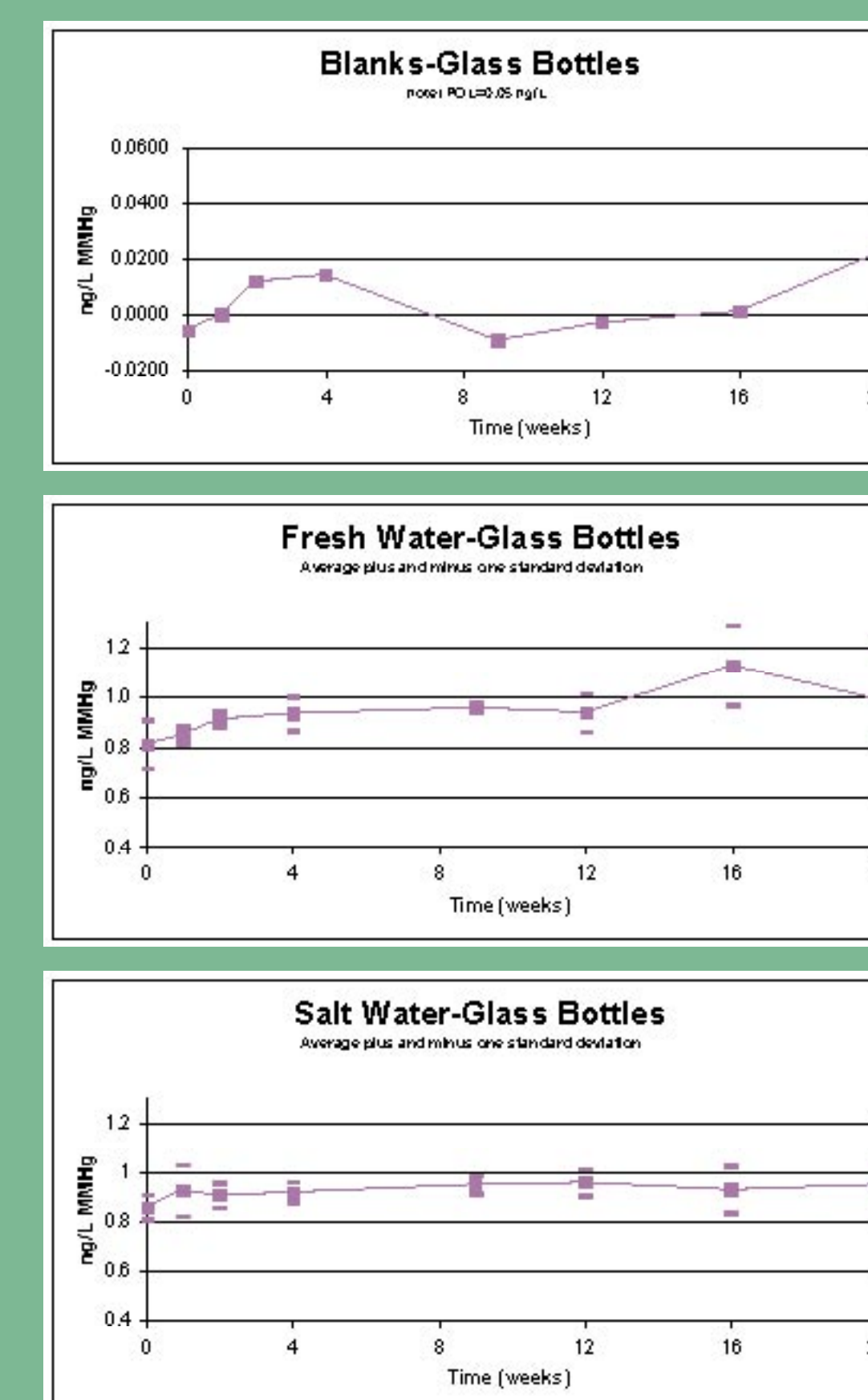
## Table 3. Summary of Results for FLPE Bottles

Time	Blanks			Saltwater			Freshwater			Contamination Blanks
	Result(ng/L)	Average(ng/L)	Standard Deviation	Result(ng/L)	Average(ng/L)	Standard Deviation	Result(ng/L)	Average(ng/L)	Standard Deviation	
Day 0	-0.0005	-0.0073	0.0078	0.6585	0.6991	0.0792	0.8096	0.8104	0.0084	-0.0075
Week 1	-0.0159	-0.0055	0.0043	0.7904	0.6484	0.0972	0.8025	0.7760	0.0424	-0.0064
Week 2	0.0209	-0.0067	0.0043	0.8103	0.8087	0.0182	0.7291	0.7760	0.0424	-0.0064
Week 4	0.0159	0.0246	0.0190	0.8807	0.9272	0.0564	0.9634	0.9178	0.0426	0.0172
Week 9	0.0115	0.0089	0.0080	0.9900	0.9066	0.0339	0.8070	0.8637	0.0688	0.0158
Week 12	0.0464	0.0172	0.0089	0.9111	0.9141	0.0402	0.8788	0.9439	0.0980	0.0158
Week 16	0.0159	0.0246	0.0190	0.8807	0.9272	0.0564	0.9634	0.9178	0.0426	0.0172
Week 20	0.0115	0.0089	0.0080	0.9900	0.9066	0.0339	0.8070	0.8637	0.0688	0.0158
Total	0.0464	0.0172	0.0089	0.9111	0.9141	0.0402	0.8788	0.9439	0.0980	0.0158



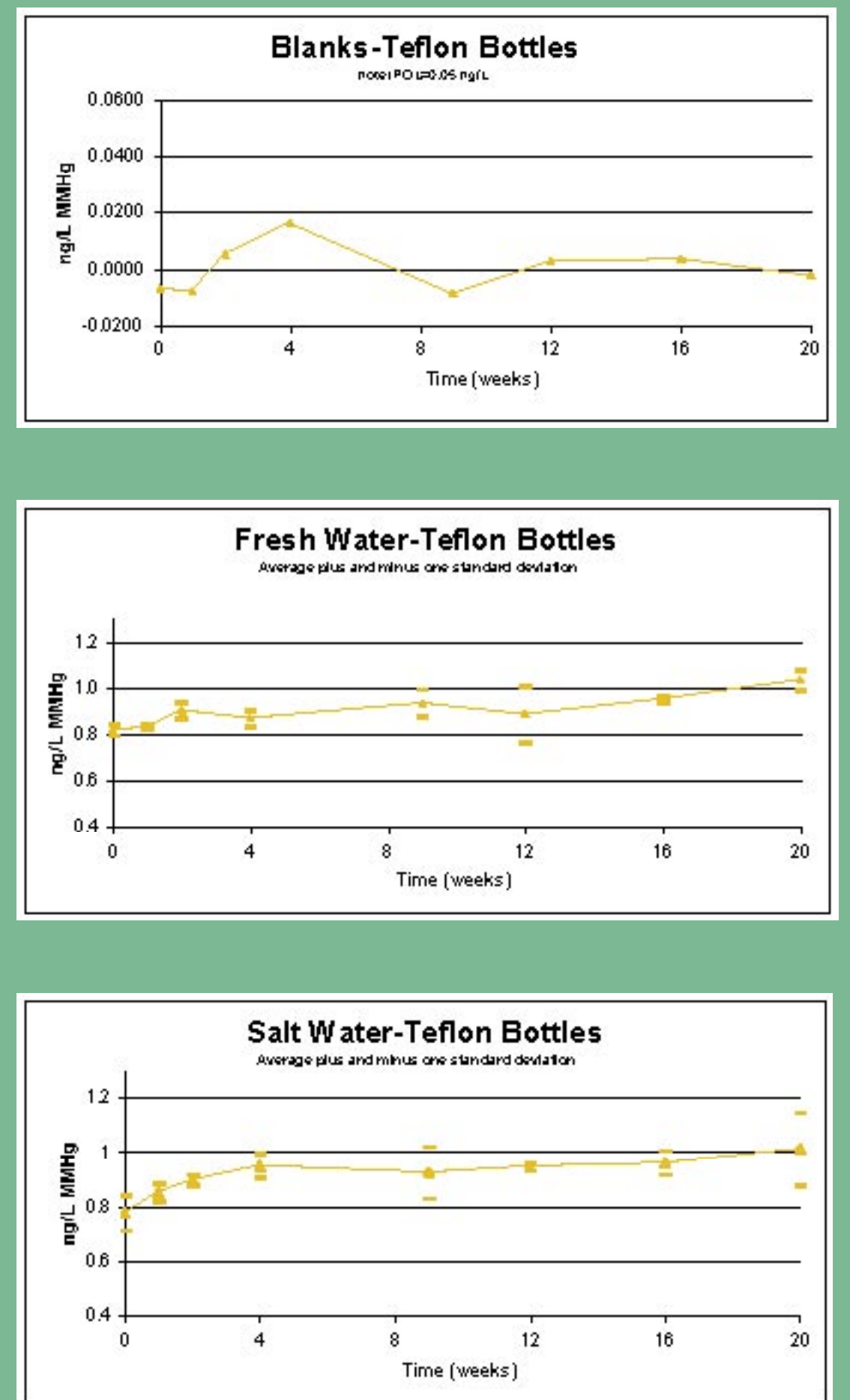
## Table 4. Summary of Results for Glass Bottles

Time	Blanks			Saltwater			Freshwater			Contamination Blanks
	Result(ng/L)	Average(ng/L)	Standard Deviation	Result(ng/L)	Average(ng/L)	Standard Deviation	Result(ng/L)	Average(ng/L)	Standard Deviation	
Day 0	-0.0034	-0.0056	0.0027	0.8429	0.8570	0.0504	0.9235	0.8116	0.0983	-0.0075
Week 1	-0.0048	-0.0056	0.0027	0.9130	0.8152	0.0504	0.7771	0.7393	0.0477	-0.0064
Week 2	0.0211	0.0002	0.0025	0.8427	0.8976	0.0504	0.8667	0.8477	0.0366	-0.0064
Week 4	0.0235	0.0119	0.0101	0.9516	0.9051	0.0492	0.8953	0.9126	0.0347	-0.0064
Week 9	0.0076	0.0114	0.0081	0.9181	0.9181	0.0492	0.9525	0.9244	0.0684	-0.0064
Week 12	0.0048	0.0114	0.0081	0.8536	0.9181	0.0492	0.8900	0.9344	0.0684	-0.0064
Week 16	0.0235	0.0119	0.0101	0.8805	0.9566	0.0478	0.8560	0.9578	0.0147	-0.014942
Week 20	0.0081	0.0091	0.0056	0.9604	0.9799	0.0382	0.9419	0.9768	0.0768	-0.0084807
Total	0.0081	0.0091	0.0056	0.9604	0.9799	0.0382	0.9419	0.9768	0.0768	-0.0084807



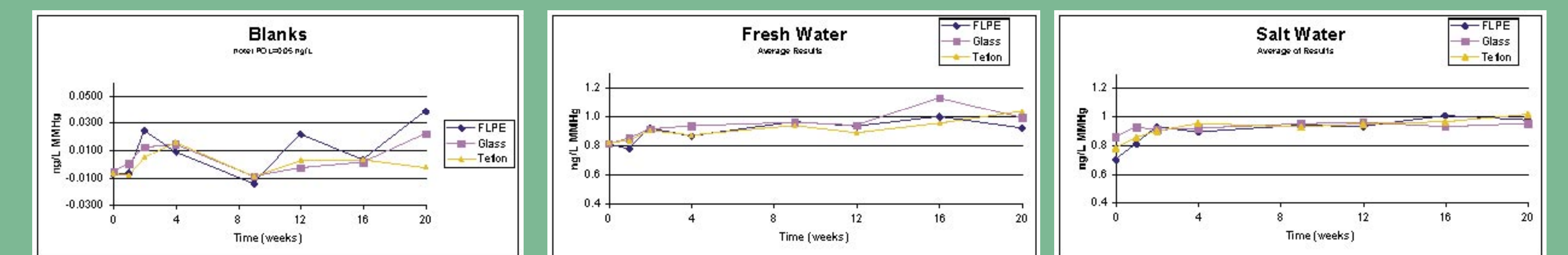
## Table 5. Summary of Results for Teflon®

Time	Blanks			Saltwater			Freshwater			Contamination Blanks
	Result(ng/L)	Average(ng/L)	Standard Deviation	Result(ng/L)	Average(ng/L)	Standard Deviation	Result(ng/L)	Average(ng/L)	Standard Deviation	
Day 0	-0.0039	-0.0069	0.0032	0.8050	0.7775	0.0643	0.8231	0.8184	0.0233	0.03967021
Week 1	-0.0104	-0.0080	0.0040	0.7040	0.8234	0.0793	0.8589	0.7931	0.0104	-0.010435
Week 2	0.0179	0.0051	0.0111	0.8359	0.8949	0.0209	0.8446	0.9026	0.0328	0.00926086
Week 4	0.0049	0.0162	0.0134	0.9220	0.9023	0.0441	0.8488	0.8700	0.0350	0.006714549
Week 9	0.0046	0.0080	0.0049	0.9400	0.9265	0.0952	0.9678	0.9348	0.0593	0.005294235
Week 12	0.0072	0.0027	0.0046	0.9367	0.9490	0.0153	0.9401	0.8859	0.1207	0.005294235
Week 16	0.0054	0.0034	0.0011	0.9445	0.9426	0.0443	0.9524	0.9524	0.0134	0.002825491
Week 20	-0.0031	-0.0024	0.0009	0.9783	0.9019	0.1037	0.9371	1.0777	1.0336	0.0423
Total	-0.0031	-0.0024	0.0009	0.9783	0.9019	0.1037	0.9371	1.0777	1.0336	0.0423



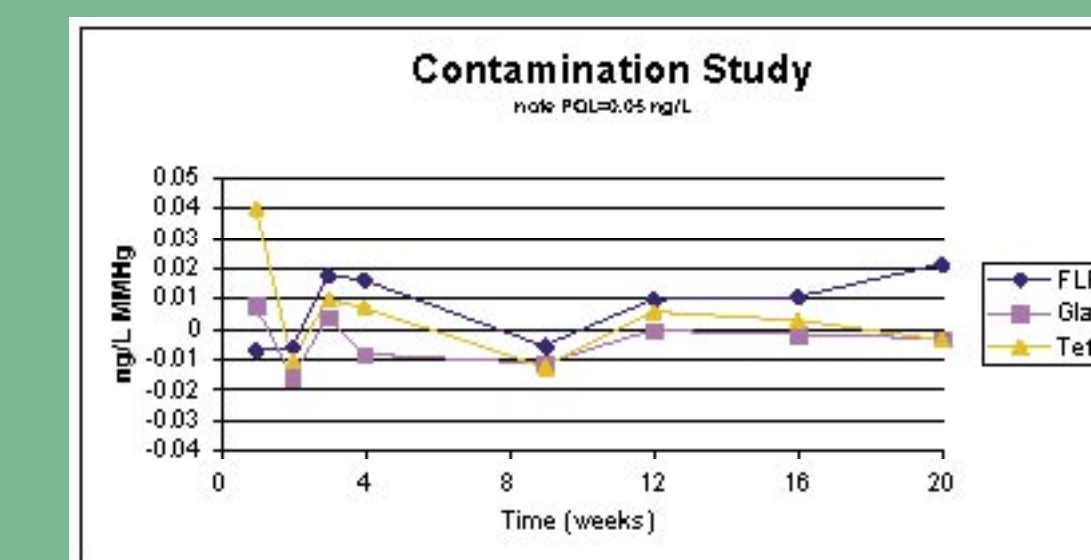
## The null hypothesis

H<sub>0</sub> => no difference between bottle types, was tested using the analysis of variance (ANOVA) at each time point. There was no significant difference between the bottle types at each time point when tested with the ANOVA.



## Contamination Study

For the contamination study, water was preserved and stored in an unregulated area in the proximity of high concentrations of monomethyl mercury. No contamination was observed.



## Discussion

This presentation demonstrates the adequacy of FLPE bottles for use in MMHg sample collection and storage, instead of the widely accepted glass and Teflon® bottles. This is shown in two separate studies. First, a holding time study compares the three bottle types and their ability to prevent loss of monomethyl mercury from a water matrix (fresh water and seawater) over time. The second part of the study tests the ability of the three bottle types to prevent contamination of the sample from an outside source.

All of the blank averages were below the lab established practical quantitation limit (PQL). Results that are below the PQL are considered unquantifiable and no statistical difference can be established. The time point that had a result that was above the PQL did not show significant difference between the bottles when the ANOVA test was applied.

There was no significant difference seen between bottle types at any of the time points for the fresh water or salt water. All of the blanks and the contamination study blanks remained uncontaminated for all bottle types for the five month time frame tested.

There was a statistically significant trend detected in both the fresh water and the salt water. Both sample types increased during the first month and then leveled off for the next four months. There was an unexpected increase seen in the concentration of monomethyl mercury over the first four weeks of one study. This is currently under further investigation at Brooks Rand.