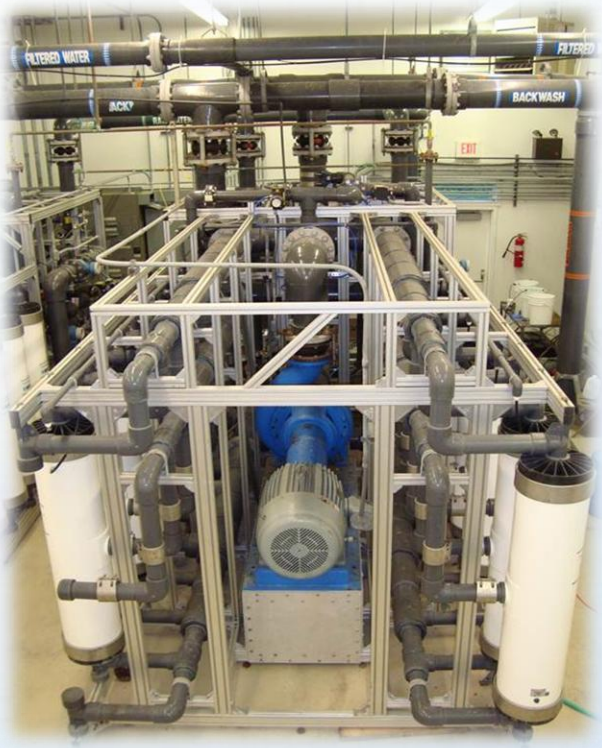

Re-Engineering a Failing UF System to Increase Reliability

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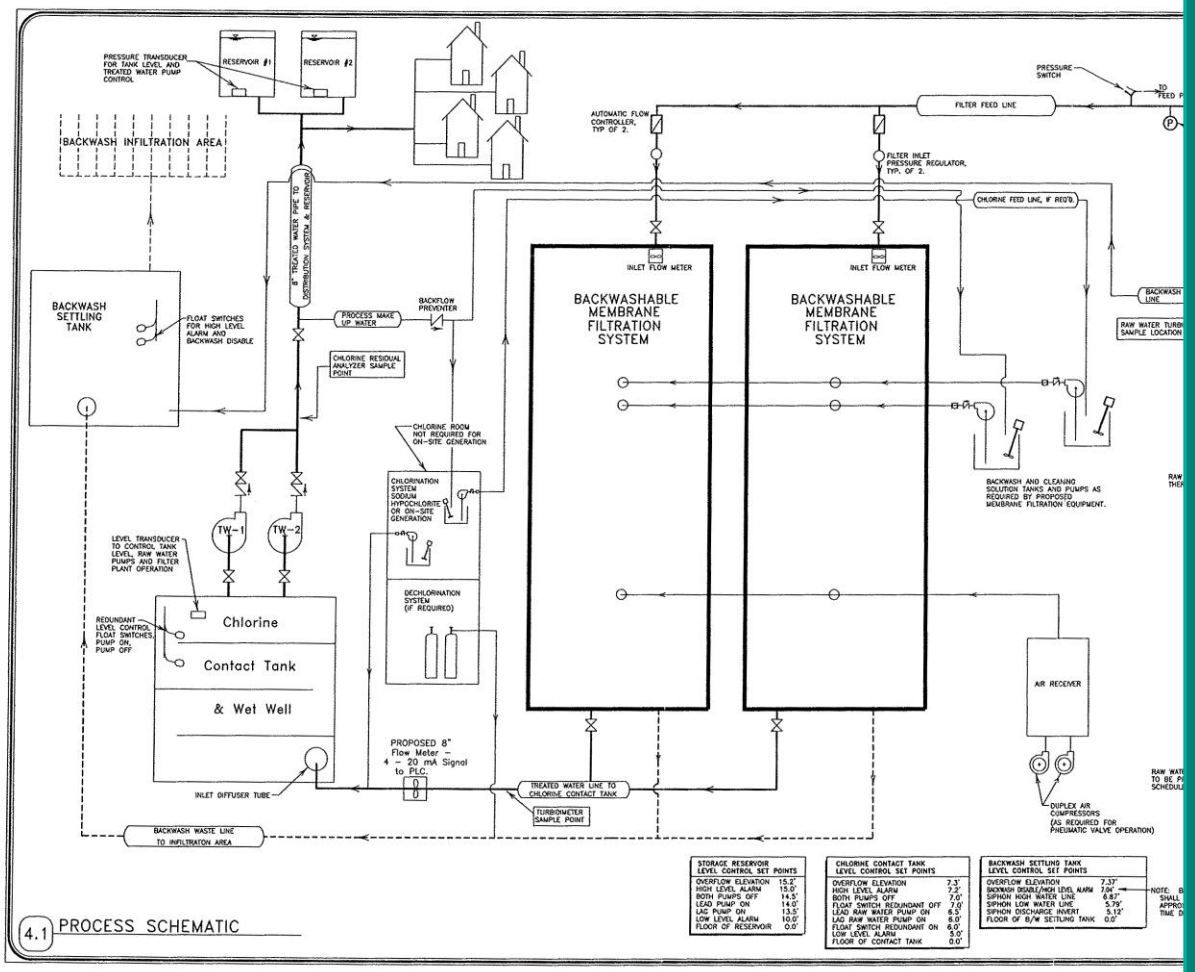
carollo
Engineers...Working Wonders With Water®

Discussion Outline

- OWA WTP Background
- Drivers for Plant Rehabilitation
- Solution Alternatives
- Criteria for Evaluating Alternatives
- Alternatives Analysis
- Solution
- Conclusions

Oden Water Association WTP



- Sandpoint, ID
- Membrane plant built in 1999
- Treats high quality water from Oden Bay
- Operates at 0.86 mgd
- Consists of two membrane racks

Drivers for Plant Rehabilitation

- Replaced all modules in 2008
- Severe integrity failures after 13 months of operation
- No longer met surface water treatment standards
- Limited membrane warranty of 12 months

Drivers for Plant Rehabilitation

Deterioration of Racks

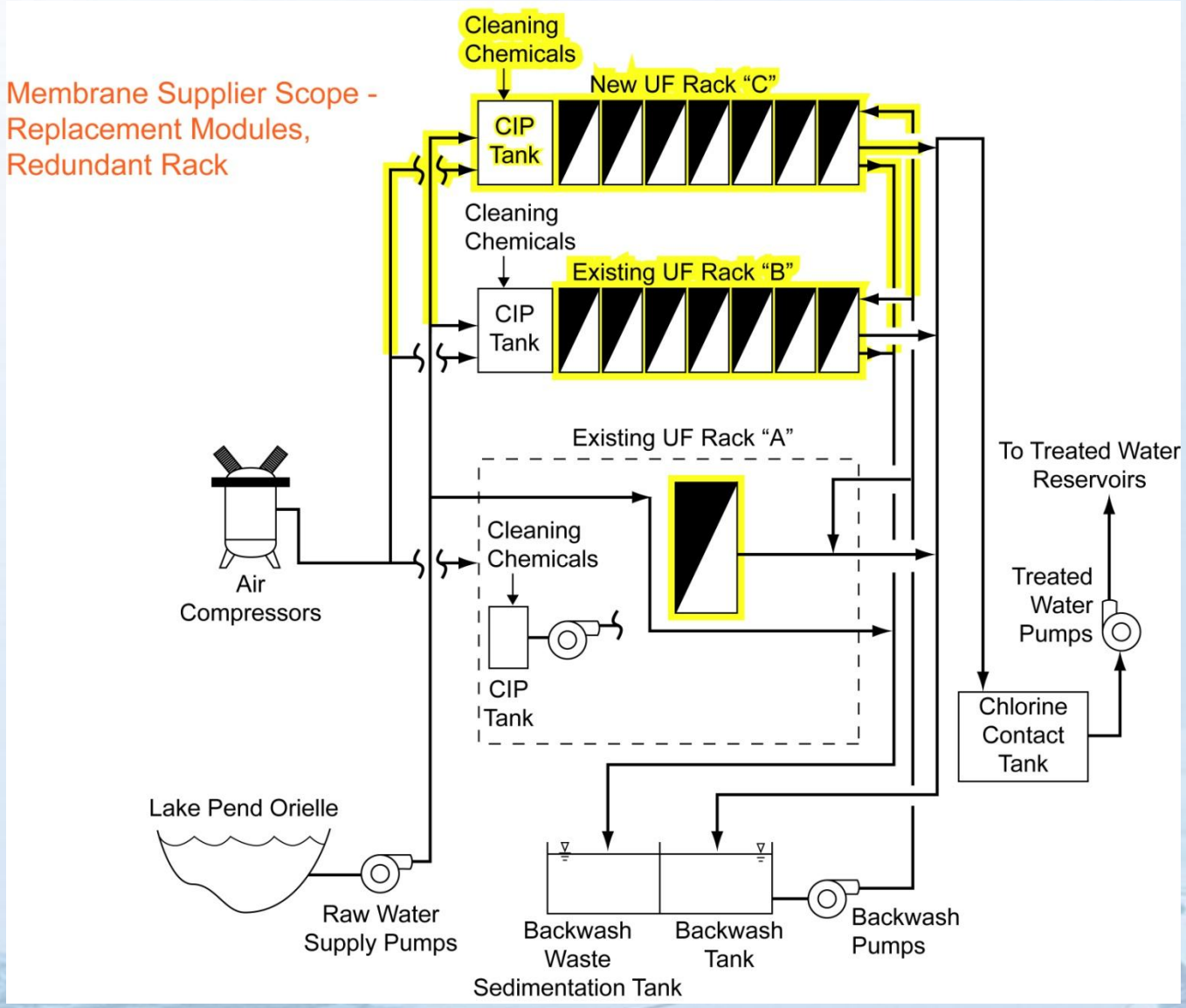
Rack Corrosion

PVC Header Damage

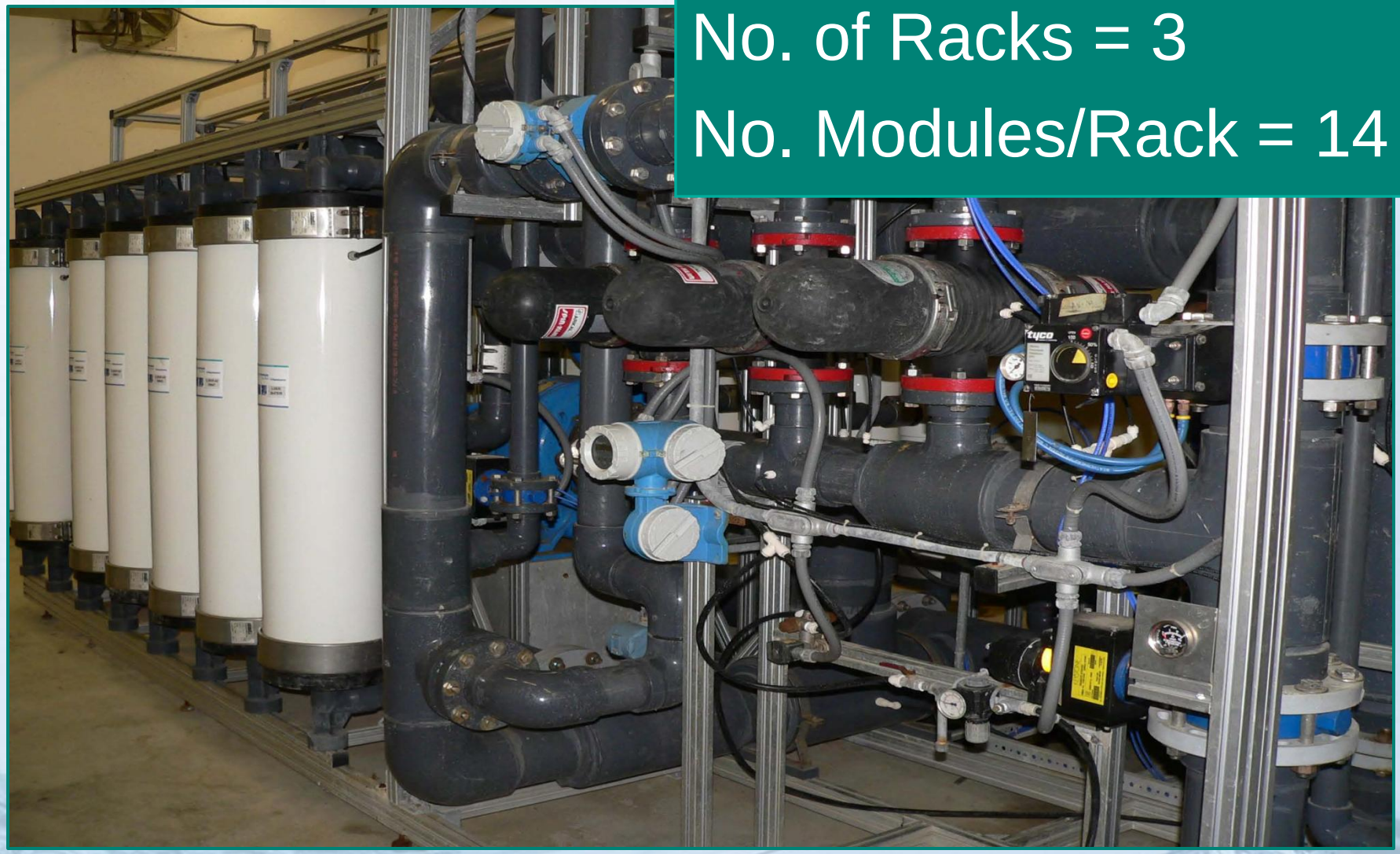
Rehabilitation Alternatives

1. Purchase replacement modules from original supplier
2. Complete replacement with new packaged membrane filtration system from alternative supplier
3. Rehabilitate existing membrane racks to accept modules from multiple membrane suppliers

Alternative 1



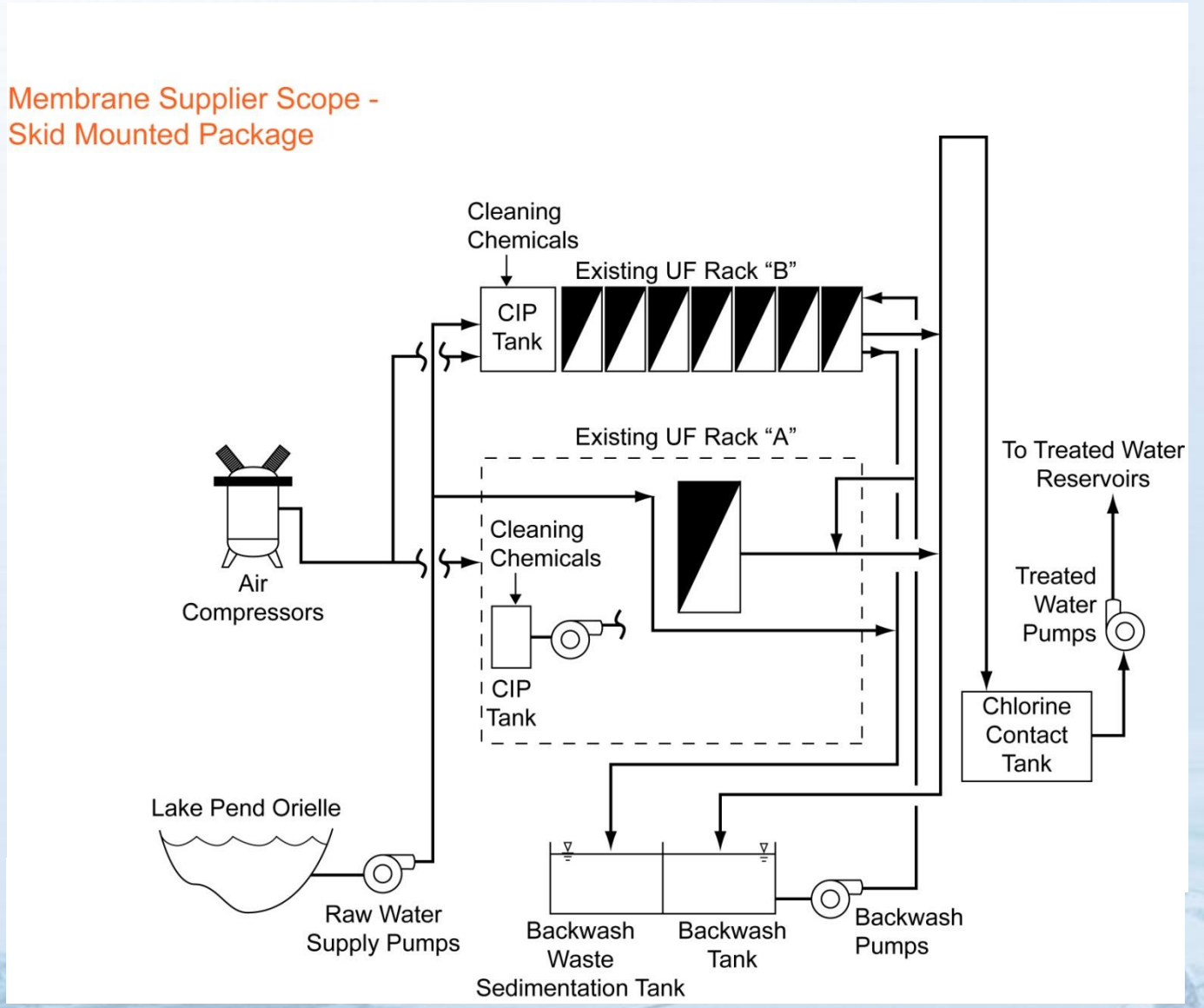
Alternative 1



No. of Racks = 3

No. Modules/Rack = 14

Alternative 2



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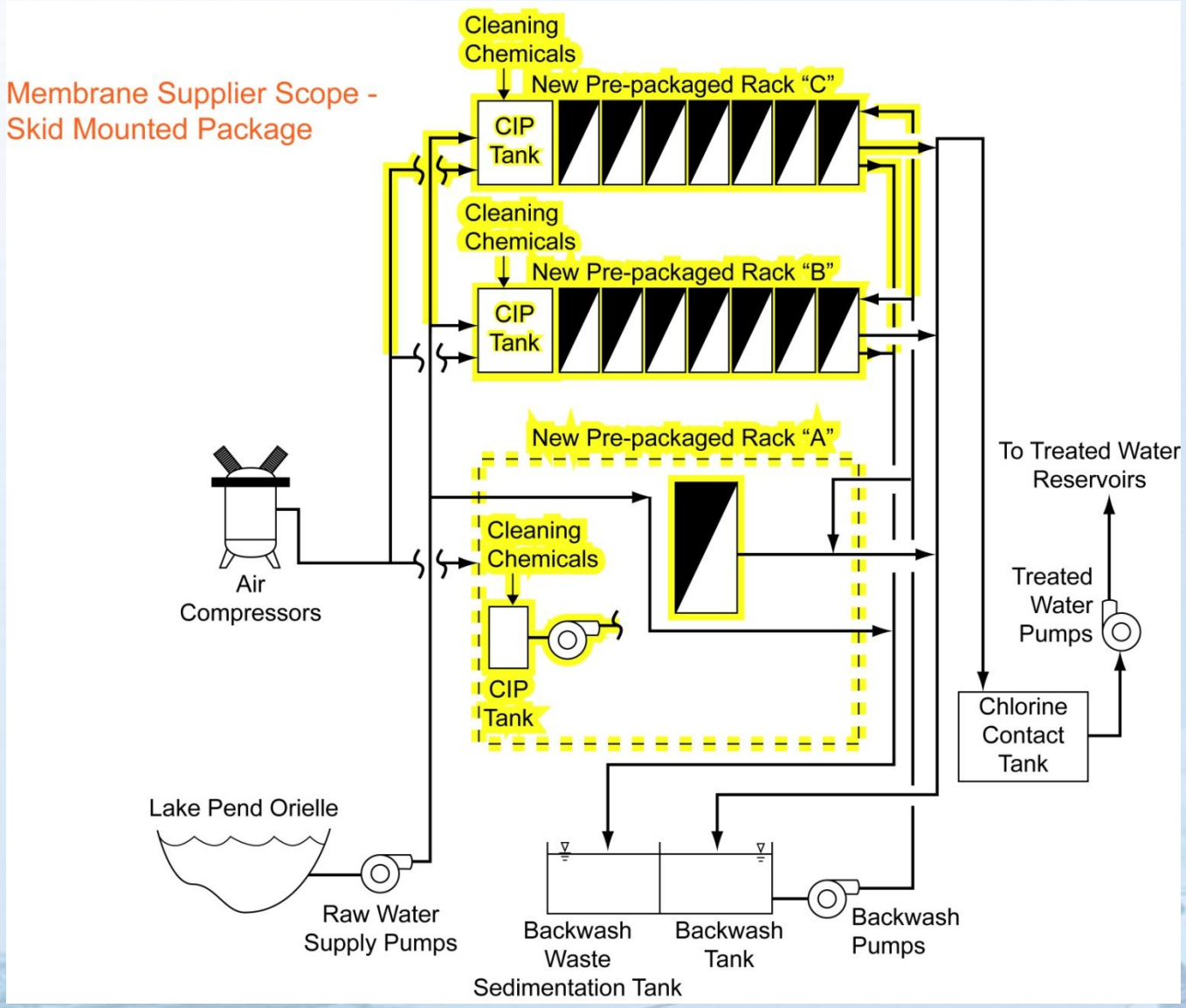
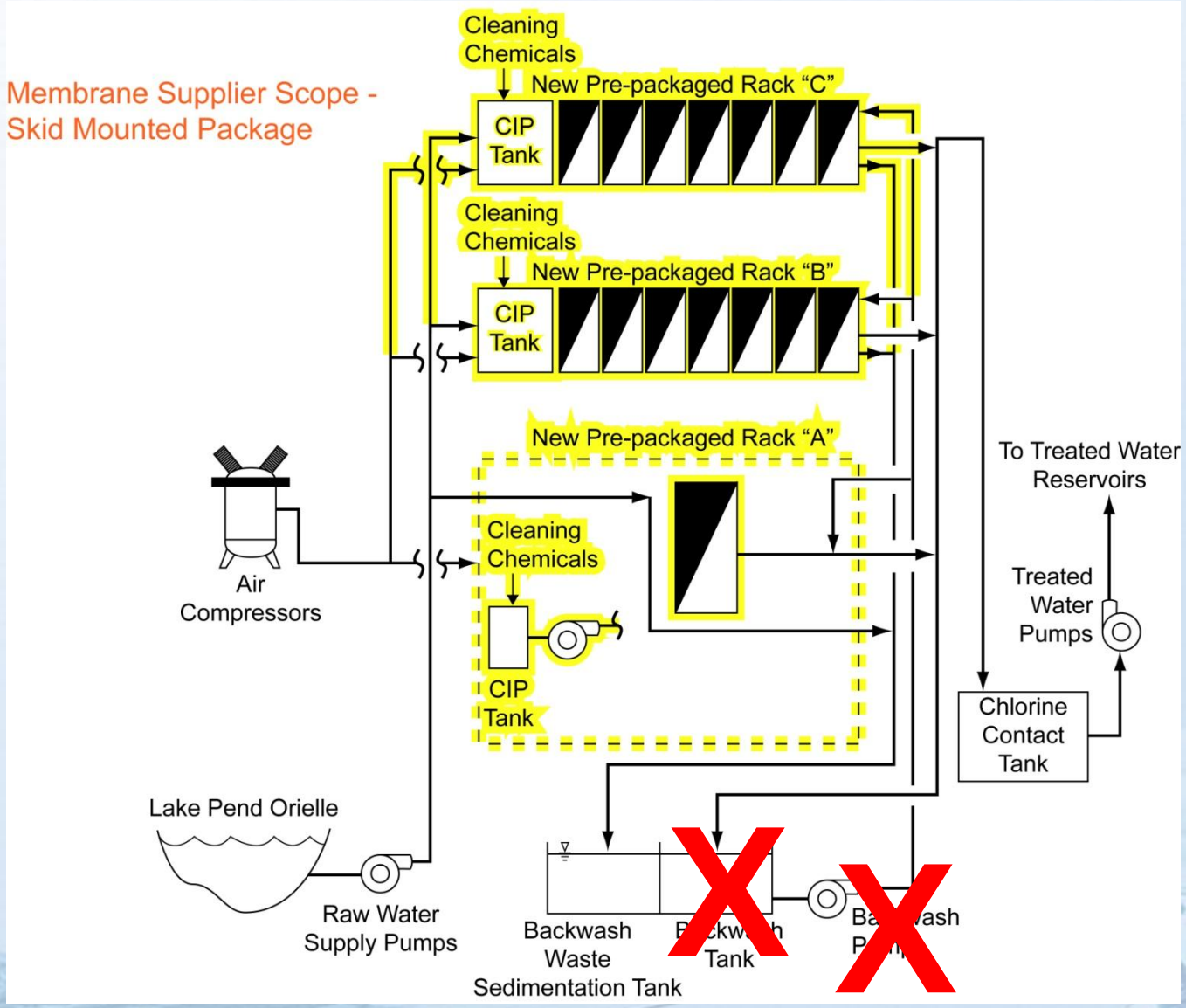


Alternative 2

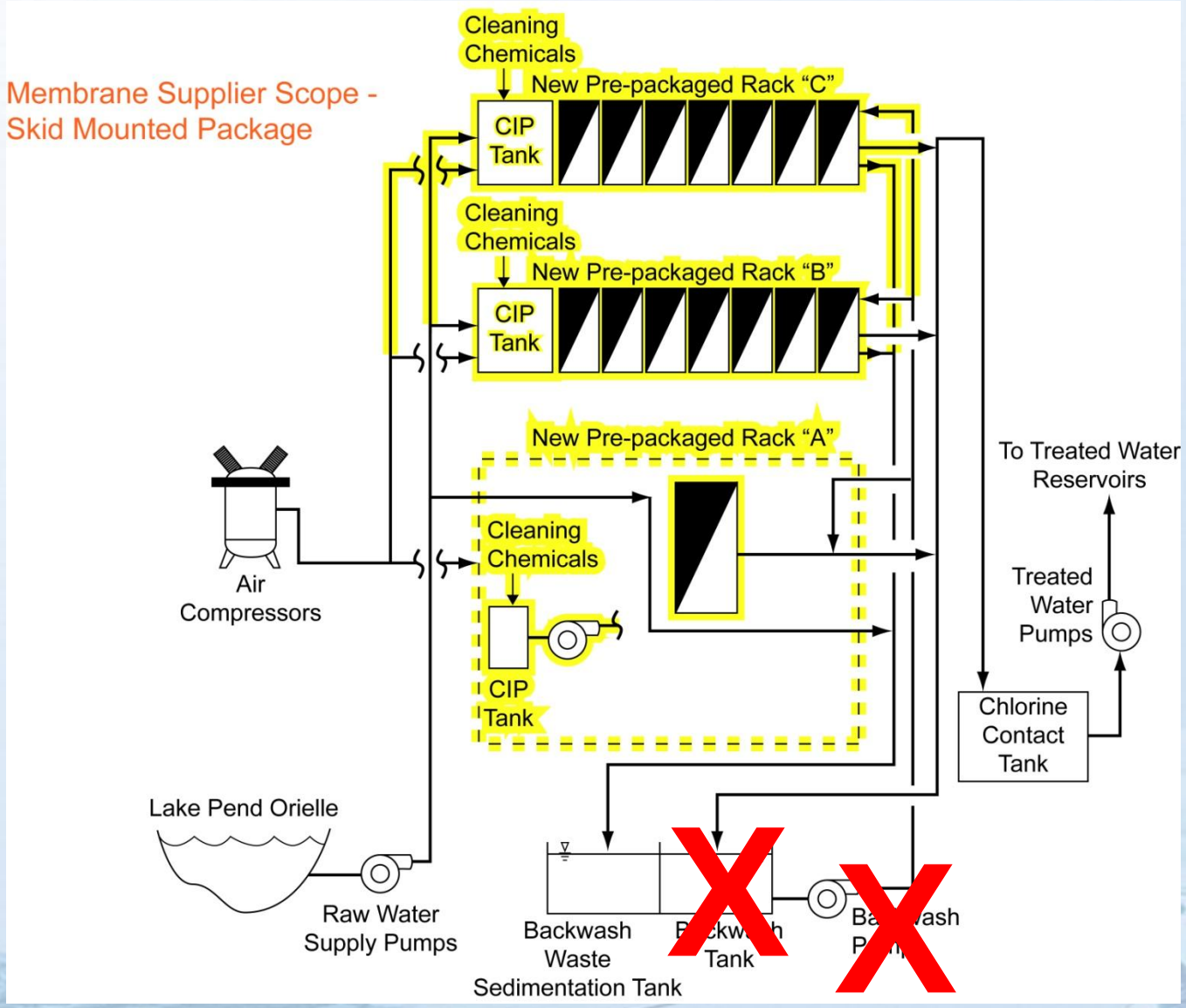


Alternative 2

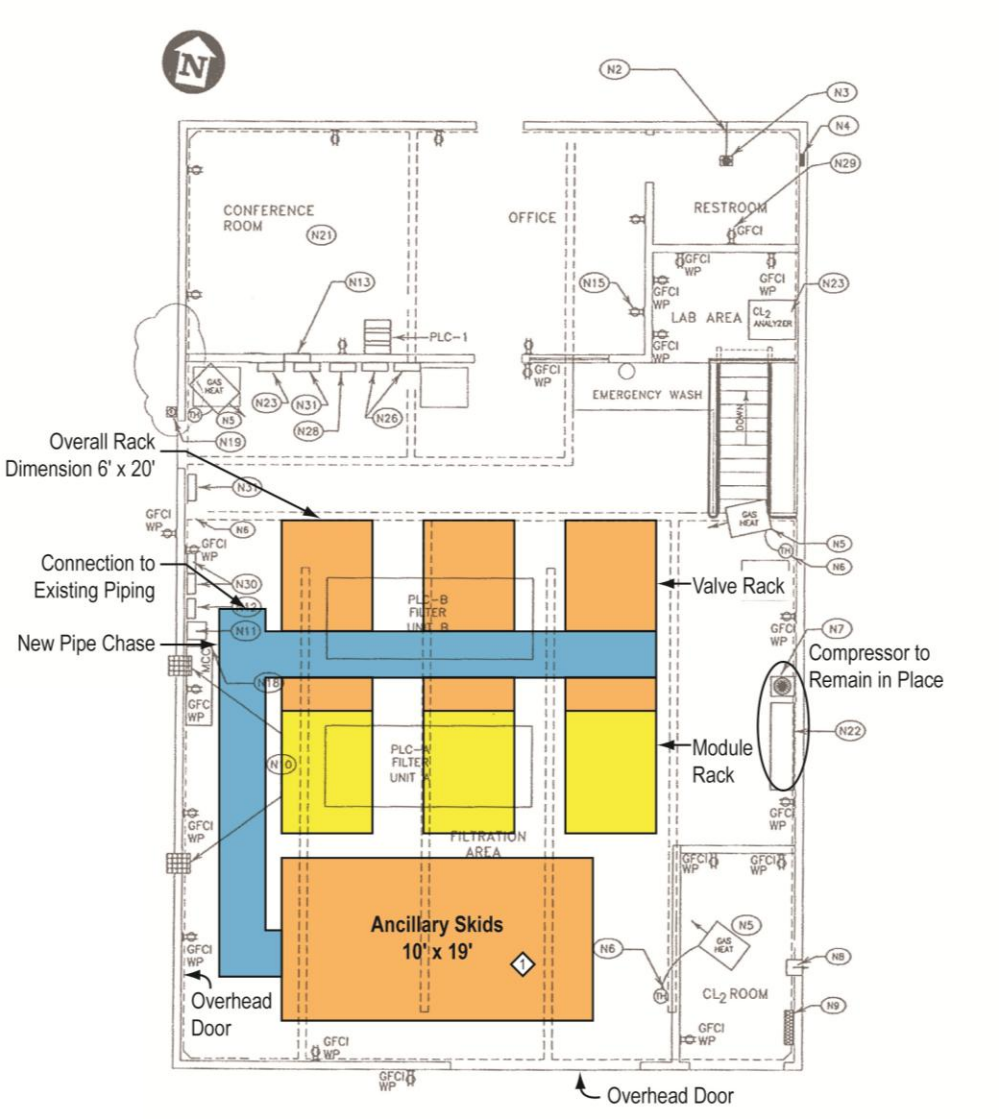
New Prepackaged, Skid Mounted Membrane System

- Modules
- Raw water tank
- Raw water pump
- Backwash tank
- Backwash pump
- CIP system
- Controls
- Air scour blower
- Chemical feeds
- Compressors

Alternative 2



Alternative 2



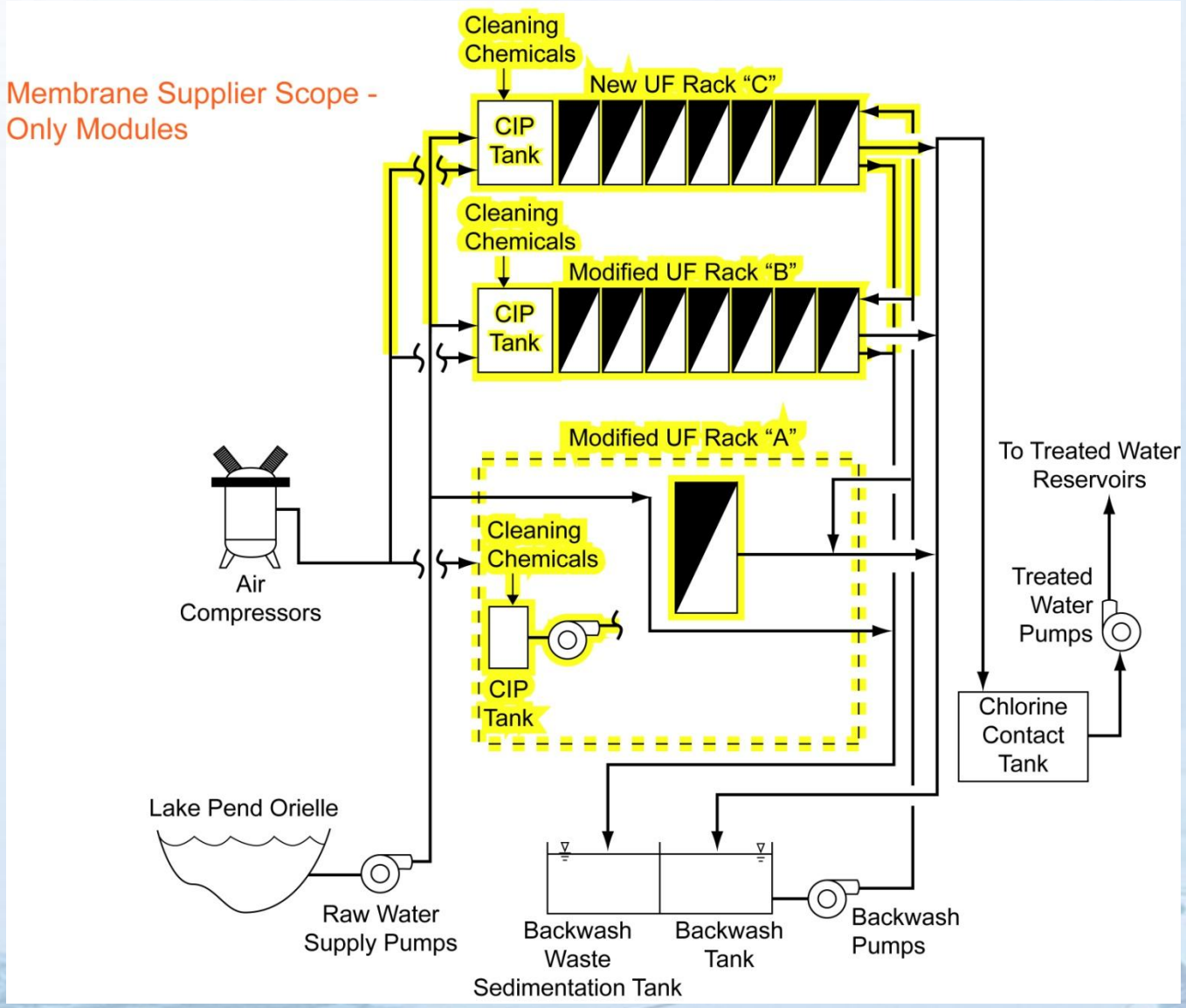
- Ancillary equipment skid cannot accommodate existing overhead doors
- Equipment access is limited or unavailable around racks

Alternative 2

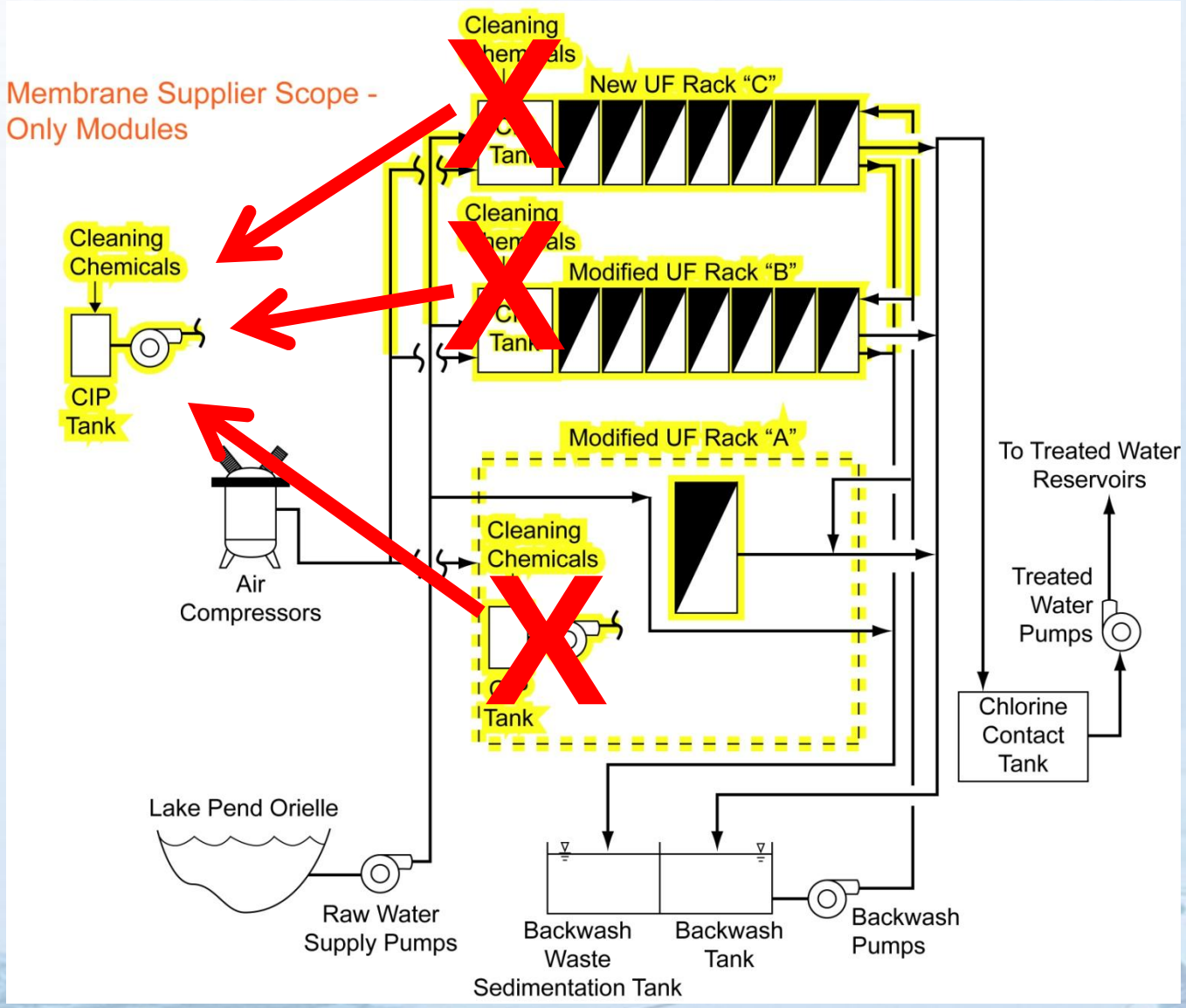
Temporary, trailer mounted, membrane water filtration system required during construction

- Wholesale changes are needed to accommodate packaged system
- Temporary system will tie into the plant electrical service, raw water pipeline, CT basin, and backwash settling tank

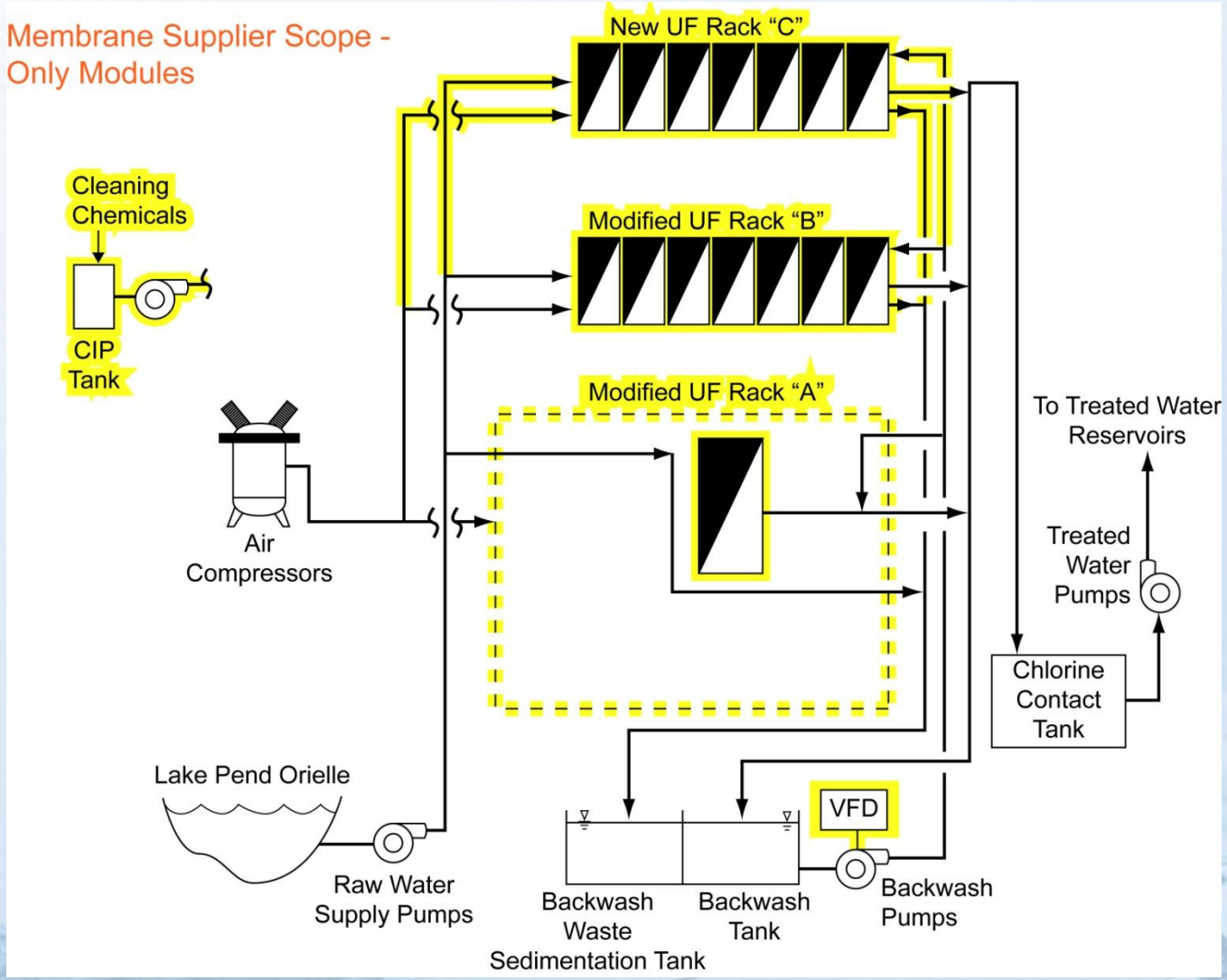
Alternative 3



Alternative 3



Alternative 3



Criteria for Evaluating Alternatives

1. Reliable production of high quality finished water
2. Physically fit into existing building
3. Maximize use of existing infrastructure
4. Provide reliable source of membranes at a reasonable cost
5. Plant must remain in operation during construction

Analysis of Alternative 1

Purchase replacement modules from original membrane supplier

Pro	Con
• Maximizes reuse of infrastructure • Easily keep plant in operation	• Membrane cost • Warranty terms • Product support

Alternative 1

Warranty terms were non-negotiable

- Purchased with 12-month warranty
- Today's market provides standard warranties for at least 5 years
- Module failures observed in less than 18 months with recent batch
- Supplier does not offer long-term warranty, unless negotiated with the original system purchase

Alternative 1

Not economically sustainable due to short useful life and relatively high membrane cost

- In 2009 OWA purchased modules for ~$11/square foot of module area
- Supplier expected price increase in 2011
- Competing systems replacements can be $3-$4/square foot of module area
- Supplier does not offer long term pricing agreement in US

Analysis of Alternative 2

Complete replacement with a new packaged membrane filtration system from an alternative supplier

Pro	Con
• Reliable long-term supply of membranes • Systems available from market leaders	• Sole source module replacement • Poor fit into plant layout • Stranded assets

Analysis of Alternative 3

Rehabilitation of existing membrane racks to accept modules from multiple membrane module suppliers

Pro	Con
• Potential for competitive module replacements • Reuse of infrastructure • Minimum impacts to plant layout	• Membrane process warranties are backed up by different entities

Schedule Comparison

	Alternative 1	Alternative 2	Alternative 3
Design/Preparation of Bid Documents	2 months	2 months	3 months
Bidding	1 month	1 month	1 month
Construction	4-6 months	8-10 months	4-6 months
Total	**7-9 months**	**11-13 months**	**8-10 months**

Cost Comparison

	Alternative 1	Alternative 2	Alternative 3
Scope Equipment	1,222,600	1,505,000	740,000
Plant Improvements	25,000	50,000	475,000
Engineering/ Contingency	381,000	602,000	425,250
Temporary Water Treatment System	0	165,000	0
Total Costs*	$1,628,600	$2,322,000	$1,640,250

*Cost estimates are intended to be budgetary under the Association for the 1998 Advancement of Cost Engineering (AACEI) guidelines. The expected accuracy range of these estimates is within +30 percent to -15 percent.

Solution

3

Rehabilitate existing membrane racks to accept modules from multiple membrane suppliers

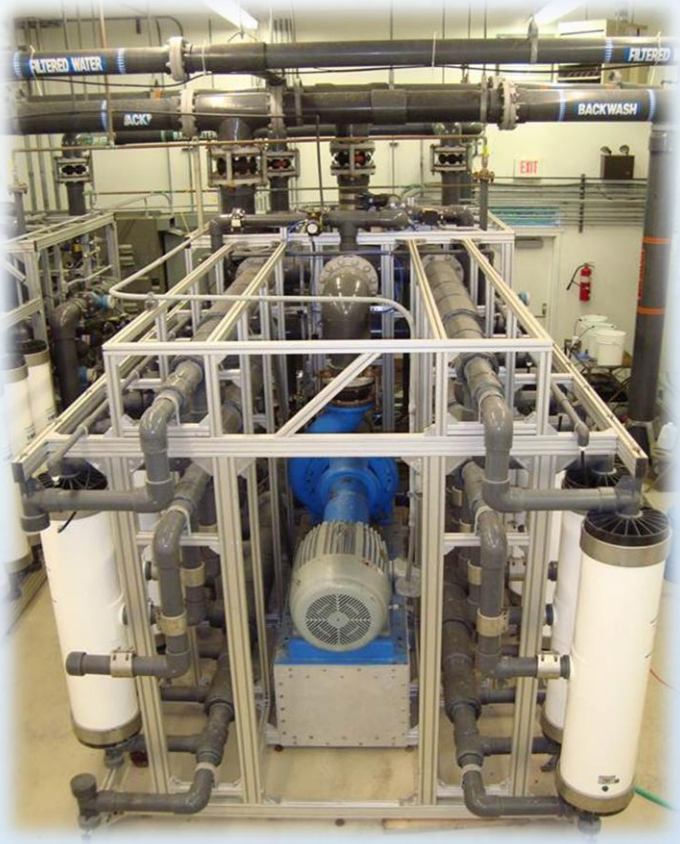
Selected due to:

- Cost competiveness
- Ease of retrofit
- Decreased reliance on single supplier for module supply

Conclusion

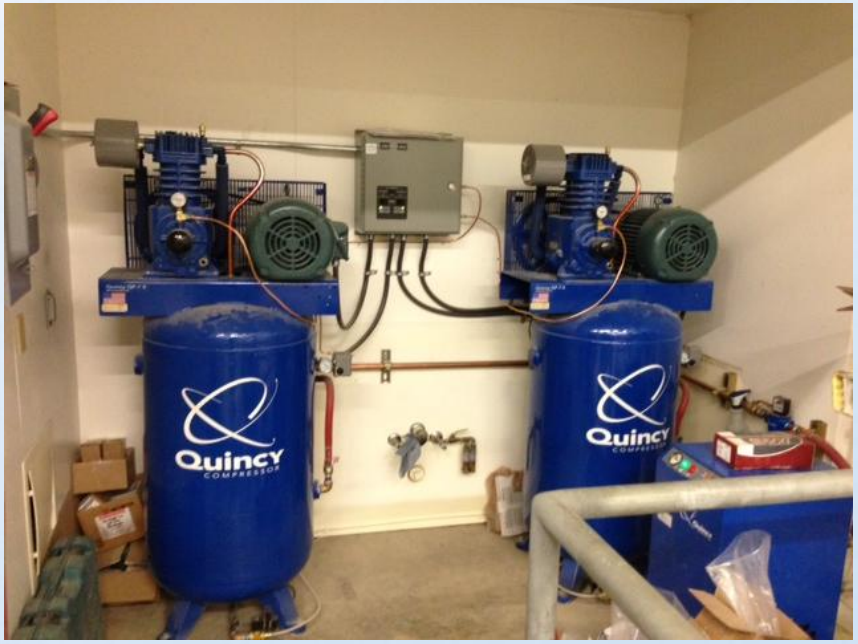
- Traditional alternatives for membrane rehabilitation were not feasible for the OWA WTP
- An interchangeable membrane system will be built in Spring 2013
- The selected approach will provide OWA with increased membrane system reliability and flexibility in the future

Membrane Rack Rehabilitation



CIP System

Compressed Air System



Questions