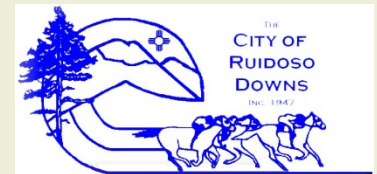
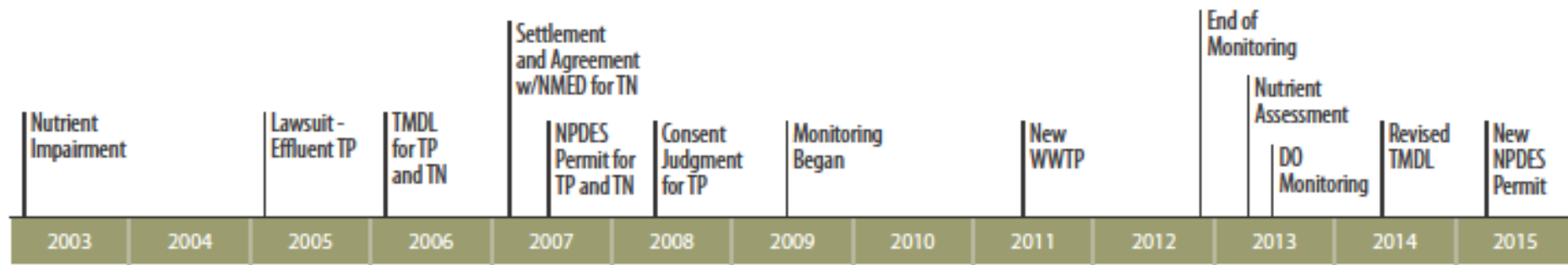


Nutrient Impairment and Compliance: the Ruidoso Experience

Western Coalition of Arid States
October 2013



Timeline for the Ruidoso Story



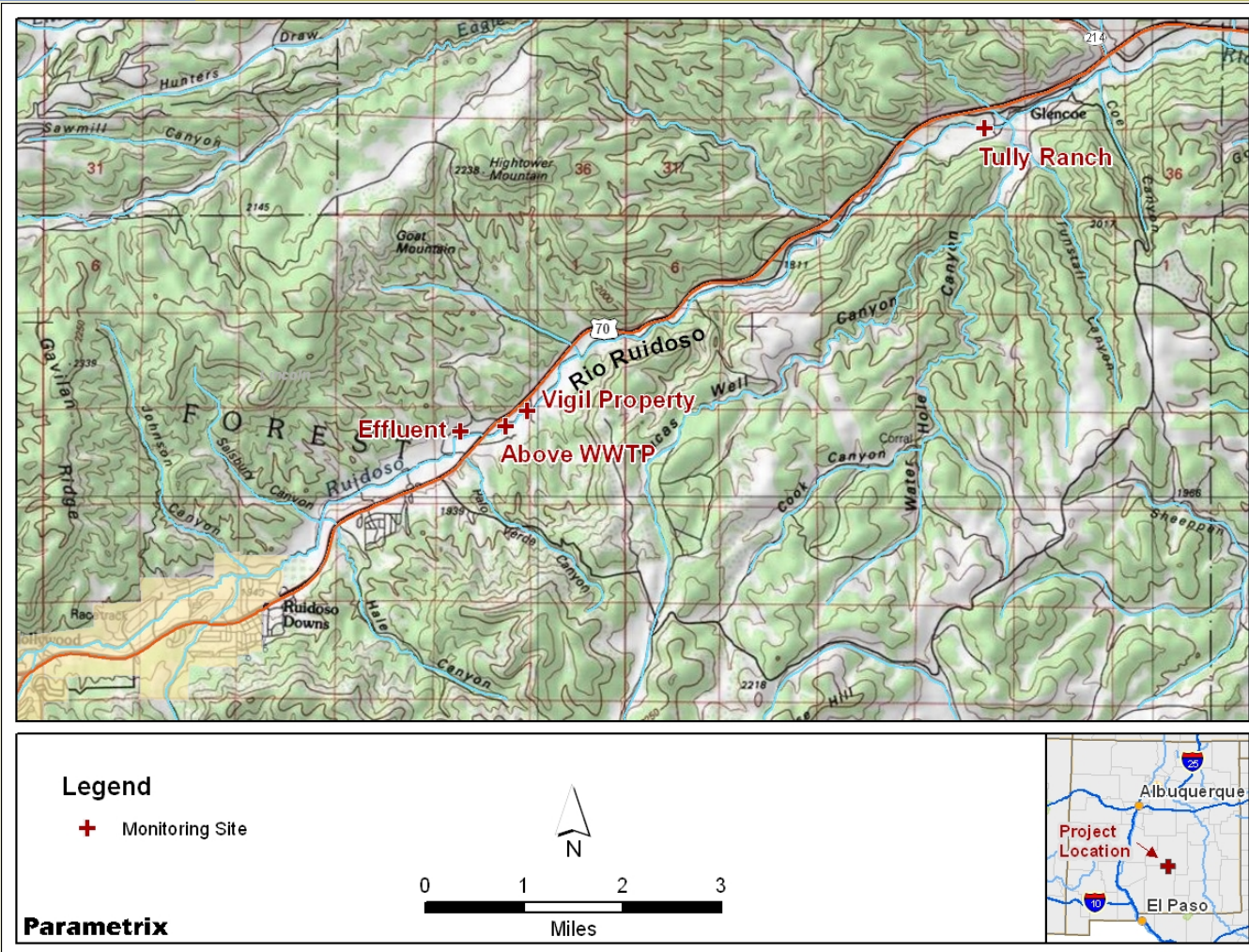
Nutrient Compliance Requirements: Pre-Monitoring

- February 2006 TMDL for TP and TN
 - 0.1 mg/L TP target based on numeric criterion
 - 1.0 mg/L TN target based on 10:1 N:P ratio
 - WLAs based on 4Q3 critical low flow
- September 2007 NPDES Permit
 - Seasonal 6.0/9.0 mg/L interim limits for TN
- March 2008 – Village of Ruidoso and City of Ruidoso Downs announced settlement with Wild Earth Guardians et al.
 - Required new \$40 M plant to treat P and N
 - Defined requirements for monitoring program

Monitoring Program Purpose

- Address 2 questions:
 - How are effluent nutrients changing, and how do they compare upstream and downstream from the WWTP?
 - How is ecological health changing in the Rio Ruidoso?
- Provide data to support a revised TMDL

Rio Ruidoso Monitoring Program Design



Rio Ruidoso Monitoring Program Design

- QAPP submitted in May 2009 to NMED
- Monthly monitoring started May 2009
 - Flow, nutrient sampling



Rio Ruidoso Monitoring Program Design

- QAPP completed in May 2009
- Monthly monitoring started May 2009
 - Flow, nutrient sampling
 - Instantaneous readings of temp, dissolved oxygen (DO), pH, turbidity, conductivity



Rio Ruidoso Monitoring Program Design

- QAPP completed in May 2009
- Monthly monitoring started May 2009
 - Flow, nutrient sampling
 - Instantaneous readings of temp, DO, pH, turbidity, conductivity
- Continuous hourly DO and pH monitoring June to September each year, plus 3 days each in December and March



Rio Ruidoso Monitoring Program Design

- Periphyton sampling began June 2009
 - Repeated each year in March, June, Aug, Oct



Rio Ruidoso Monitoring Program Design

- Periphyton sampling began June 2009
 - Repeated each year in March, June, Aug, Oct
 - USEPA Rapid Bioassessment Protocols Rapid Periphyton Survey
 - Photographs at each stream reach



Rio Ruidoso Monitoring Program Design

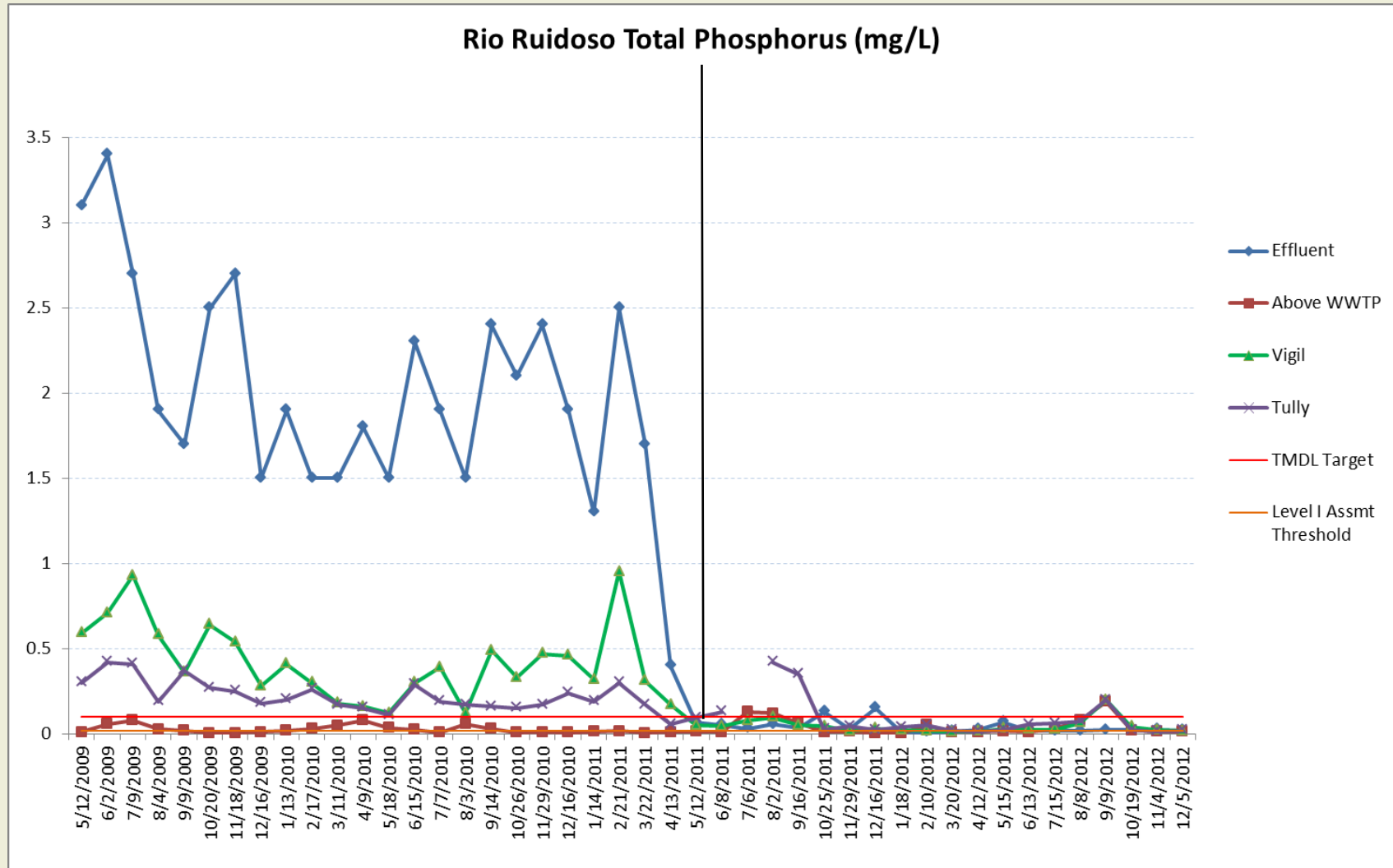
- Benthic Macroinvertebrate sampling began October 2009
 - Repeated each March and October
 - Following USEPA Rapid Bioassessment Protocols



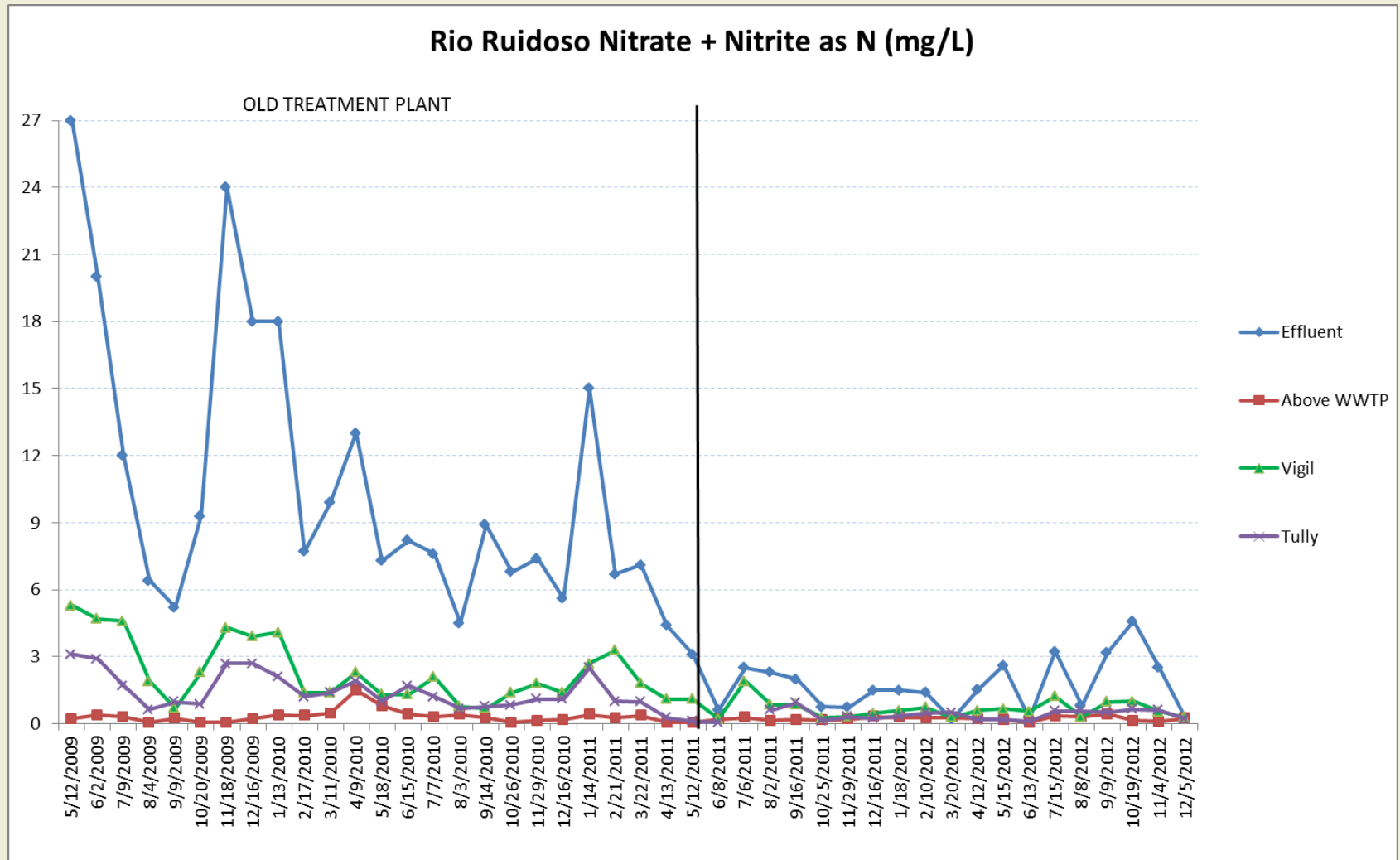
Rio Ruidoso Monitoring Program Results

- Nutrient Concentrations
 - Total P concentrations in effluent and downriver dropped dramatically starting in April 2011
 - Nitrate concentrations in effluent and downriver also dropped to no more than a few mg/L, placing the Ruidoso plant among the best in the U.S. for nutrient removal
- Nutrient Loading
 - Effluent phosphorus loading consistently below 2.72 lb/d TMDL target since May 2011, not so in river upstream
 - Nitrogen loading in effluent below 27.2 lb/d TMDL target during some events

Nutrient Concentrations



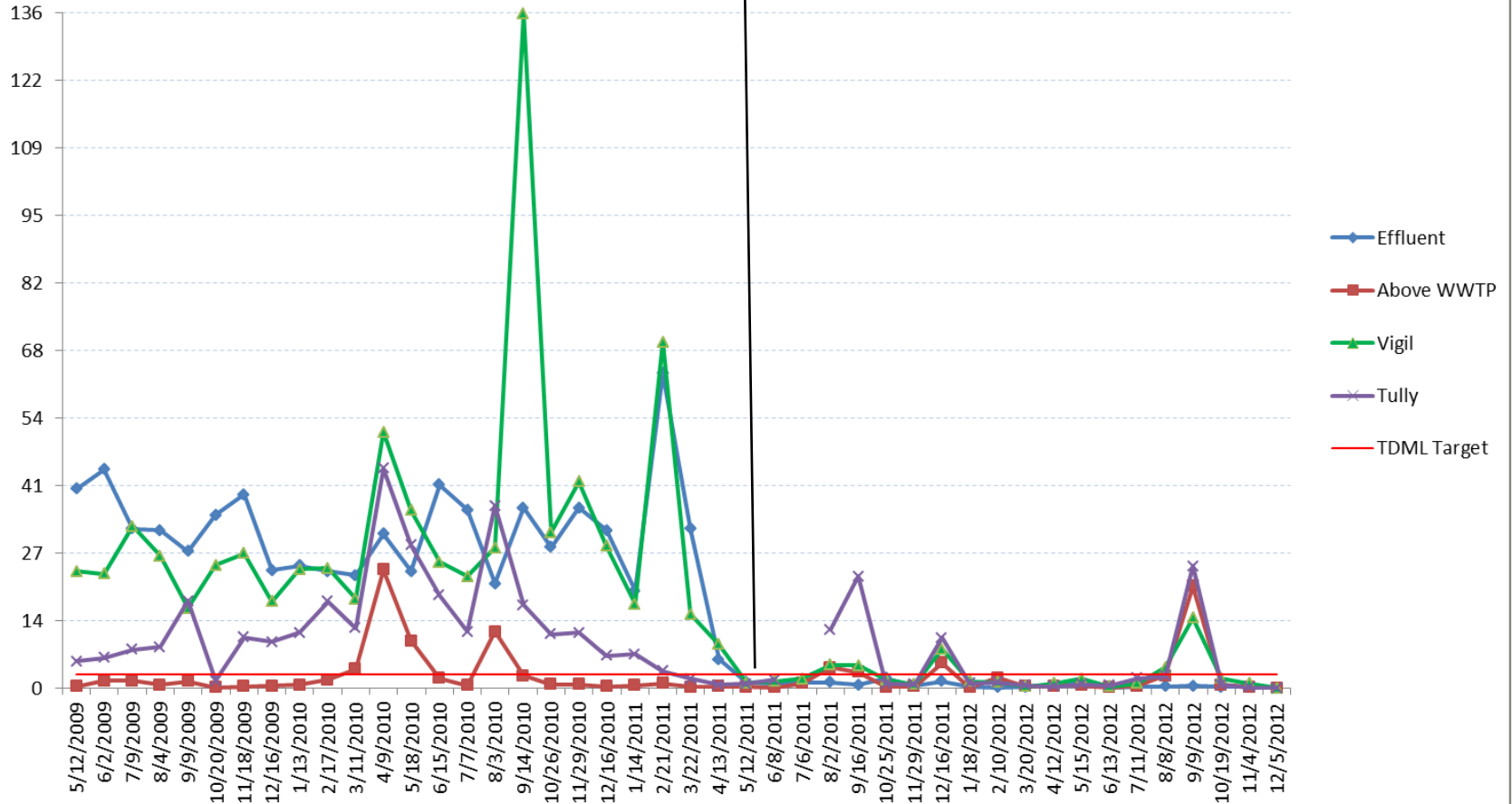
Nutrient Concentrations



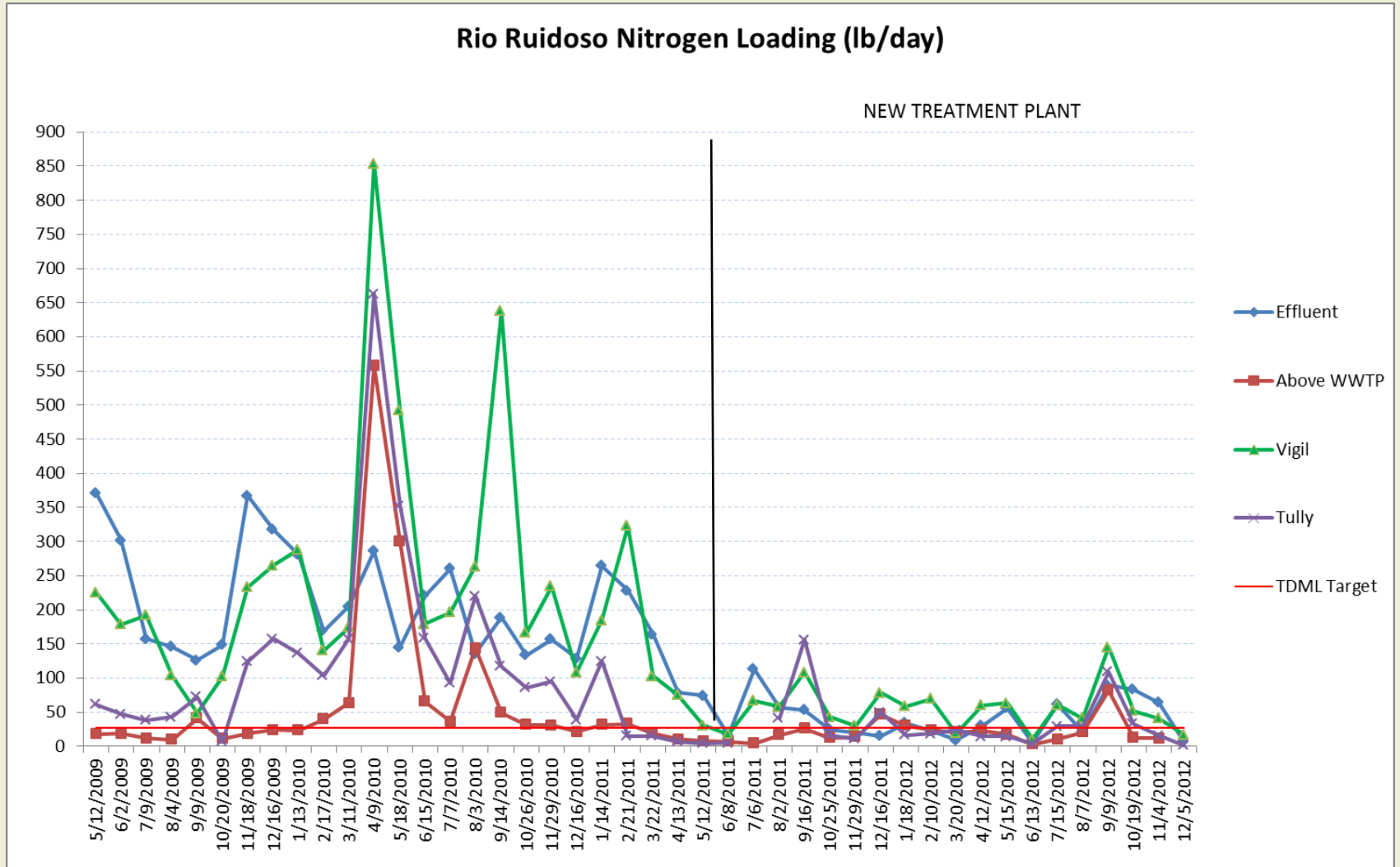
Nutrient Loading

Rio Ruidoso Phosphorus Loading (lb/day)

NEW TREATMENT PLANT



Nutrient Loading

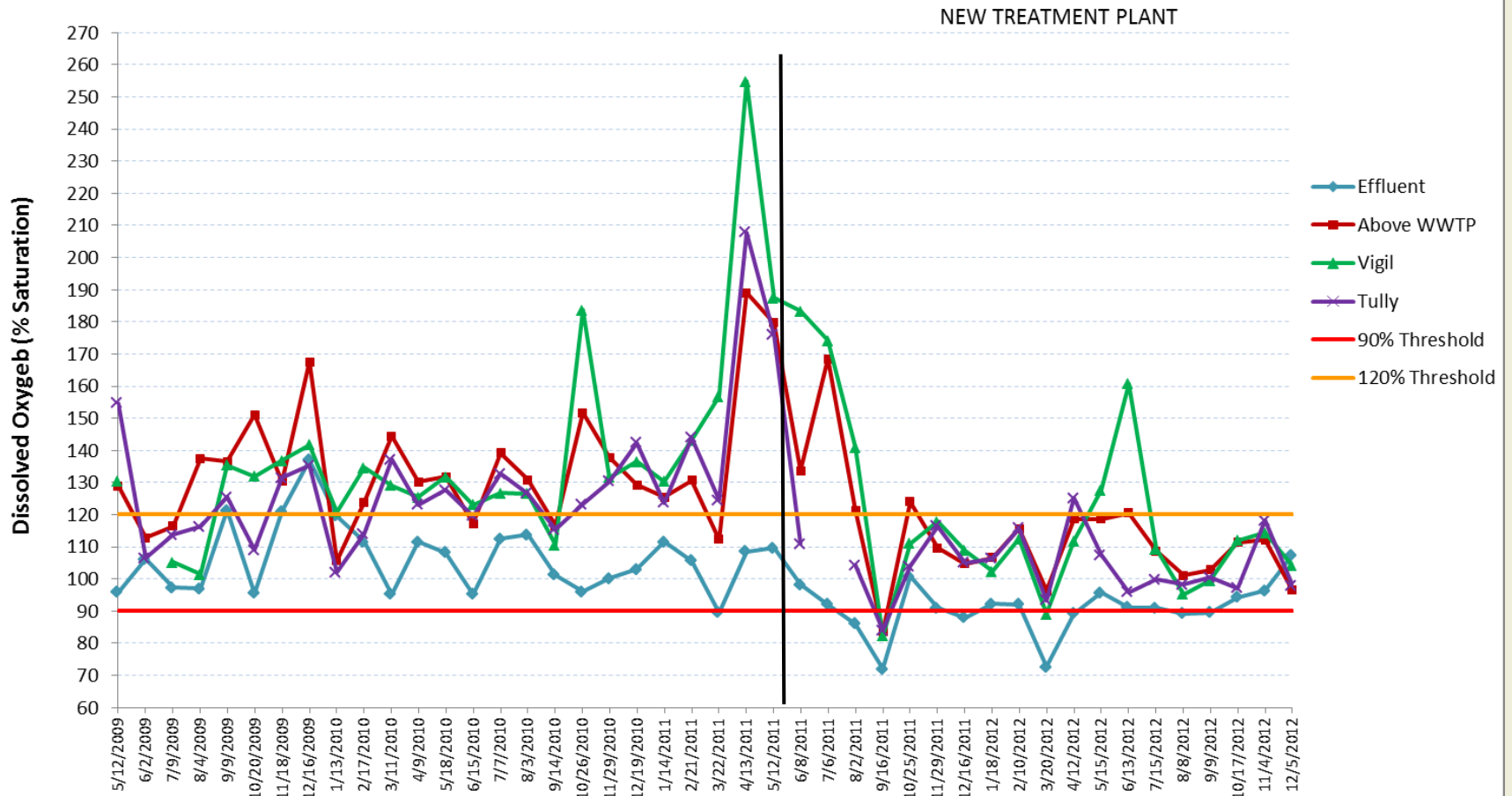


Rio Ruidoso Monitoring Program Results

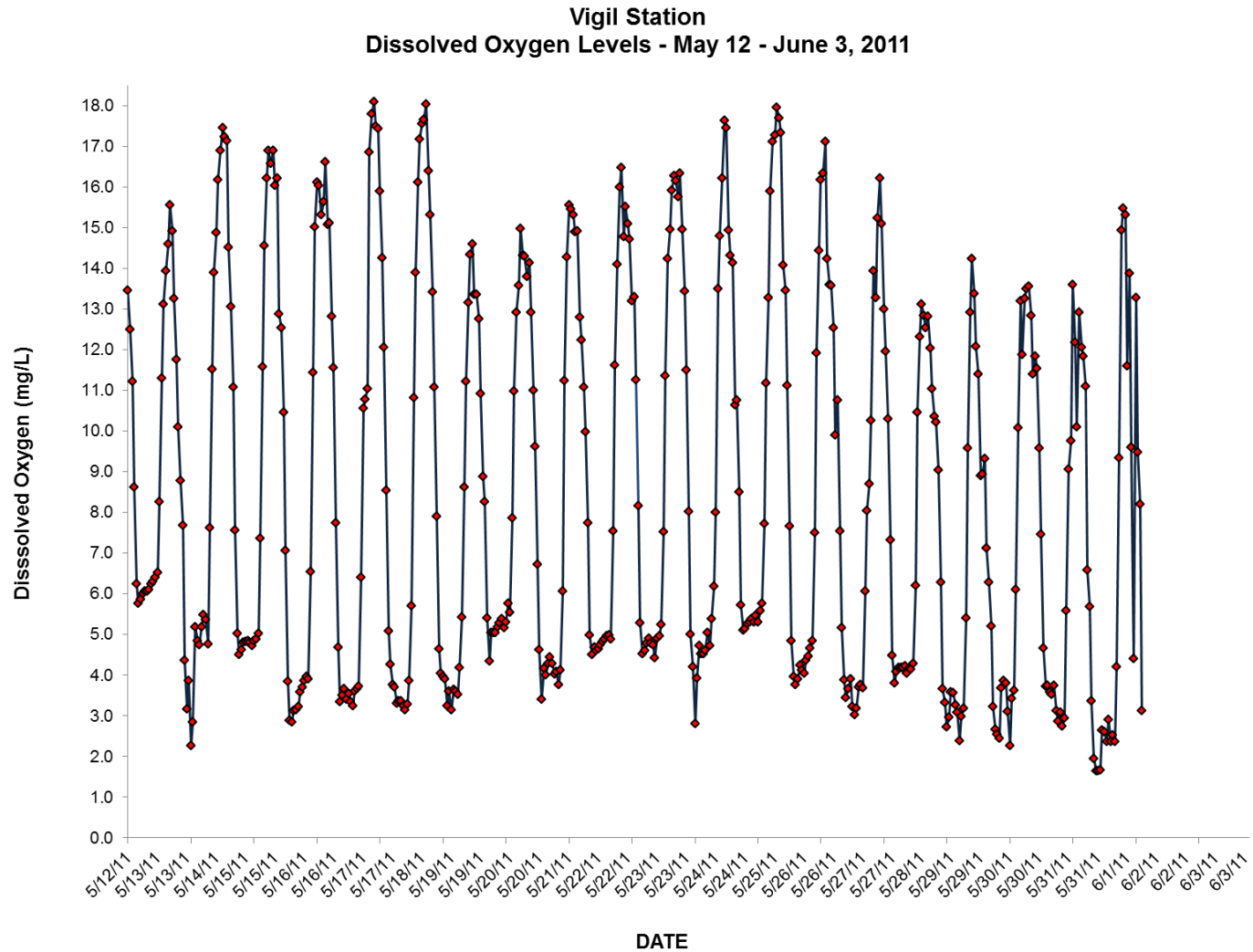
- Dissolved Oxygen
 - Supersaturation (>120%) common before new treatment plant, uncommon in monthly instantaneous measurements with new WWTP
 - Downstream DO was commonly below 6.0 mg/L and 90% saturation for at least 4 consecutive hours before the new WWTP, much less frequently with the new plant
 - Downstream diel DO fluctuation was typically 10 to 15 mg/L during high periphyton biomass periods before the WWTP, but typically 1 to 3 mg/L with the new plant
- The pH thresholds were met both before and after the new WWTP

Dissolved Oxygen Saturation

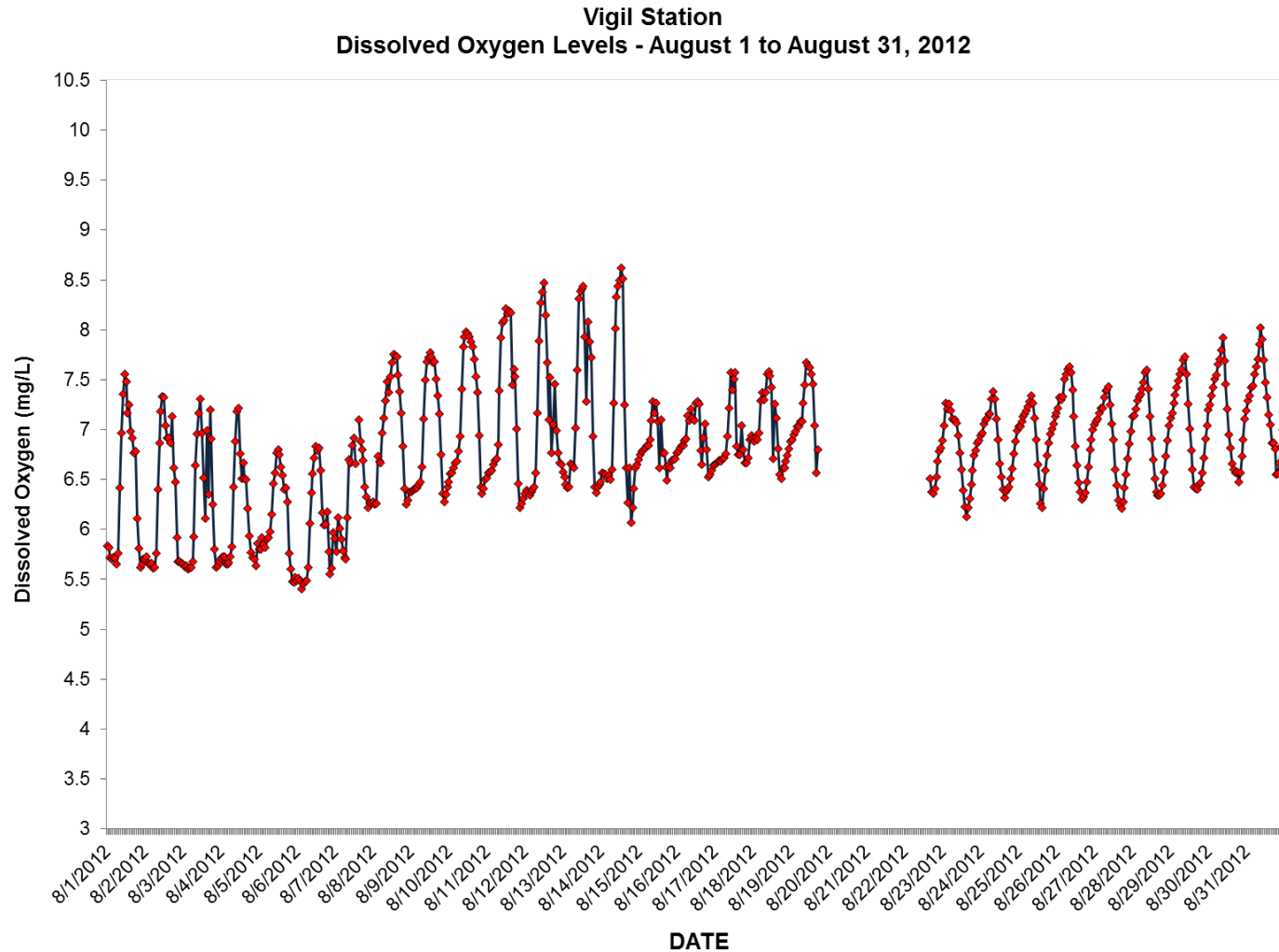
Rio Ruidoso Dissolved Oxygen (% Saturation)
(Instantaneous Measurements)



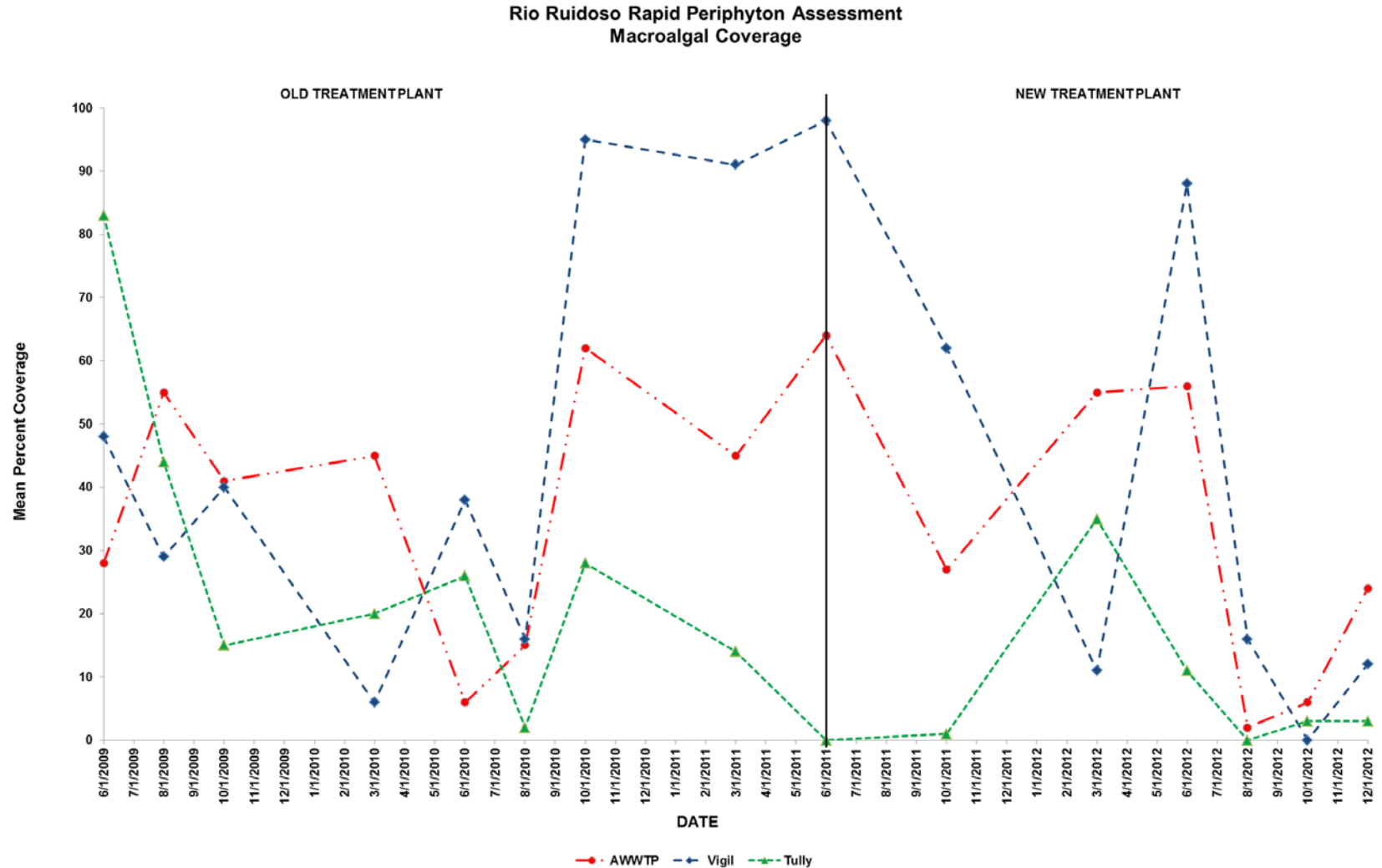
Dissolved Oxygen Concentrations Before



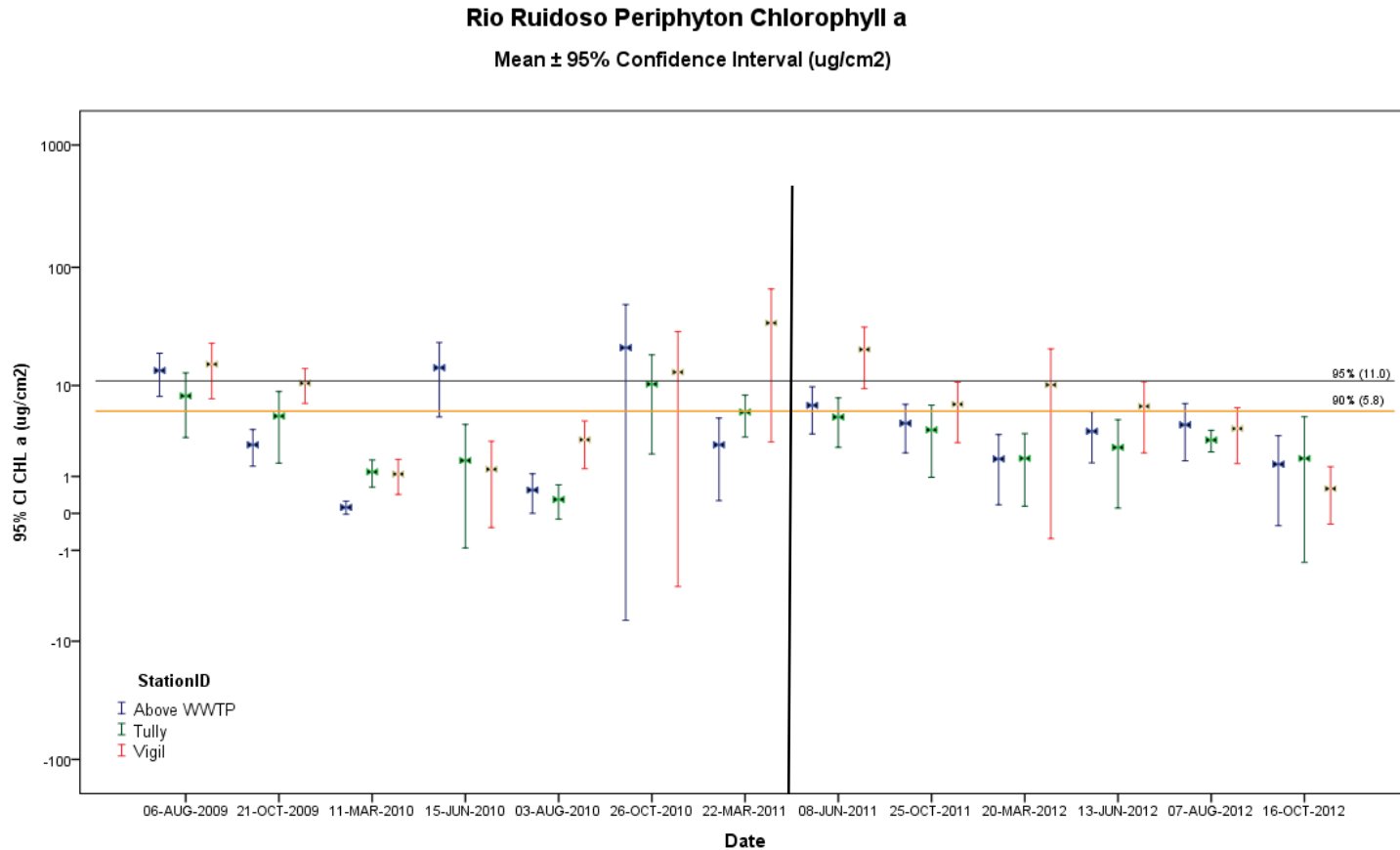
Dissolved Oxygen Concentrations After



Rapid Periphyton Assessment – Macroalgae



Periphyton Biomass – Chlorophyll *a*



Level I Nutrient Assessment Summary

| Nutrient Assment Indicators | | | Indicates Fully Supporting | Indicates Not Supporting | Notes | | |
|------------------------------------|--|--|----------------------------|--------------------------|-------------------------|--|--|
| Level I Nutrient Assessment | | | | | | | |
| <i>Causal Variables</i> | | | | | | | |
| Total Nitrogen >0.25 | | | | X | always exceeded | | |
| Total Phosphorus >0.02 | | | | X | frequently exceeded | | |
| | | | | | | | |
| <i>Response Variables</i> | | | | | | | |
| Dissolved Oxygen >120% saturation | | | X | | based on last 6 events | | |
| pH >8.8 | | | X | | based on last 13 events | | |
| Algae Coverage >50% | | | X | | based on last 3 events | | |
| Microalgae >1 mm thick (rating >2) | | | X | | | | |
| Anoxia present | | | X | | | | |

Level II Nutrient Assessment Summary

| Nutrient Assment Indicators | Indicates Fully Supporting | Indicates Not Supporting | Notes |
|---|----------------------------|--------------------------|----------------------------------|
| Level II Nutrient Assessment | | | |
| <i>Causal Variables</i> | | | |
| Total Nitrogen >0.25 | | X | always exceeded |
| Total Phosphorus >0.02 | | X | frequently exceeded |
| <i>Response Variables</i> | | | |
| <i>Large Data Sets</i> | | | |
| DO <6.0 mg/L AND >120% saturation | | X | improving |
| DO diel fluctuations >3 mg/L | X | | based on data since July 2012 |
| pH <6.6 or >8.8 | X | | 2 occurences due to invalid data |
| <i>Grab Samples</i> | | | |
| Dissolved Oxygen >120% saturation | X | | |
| Dissolved Oxygen <6.0 mg/L | X | | |
| pH <6.6 or >8.8 | X | | |
| Chlorophyll <i>a</i> < 5.8 µg/cm ² | X | | based on last 3 events |

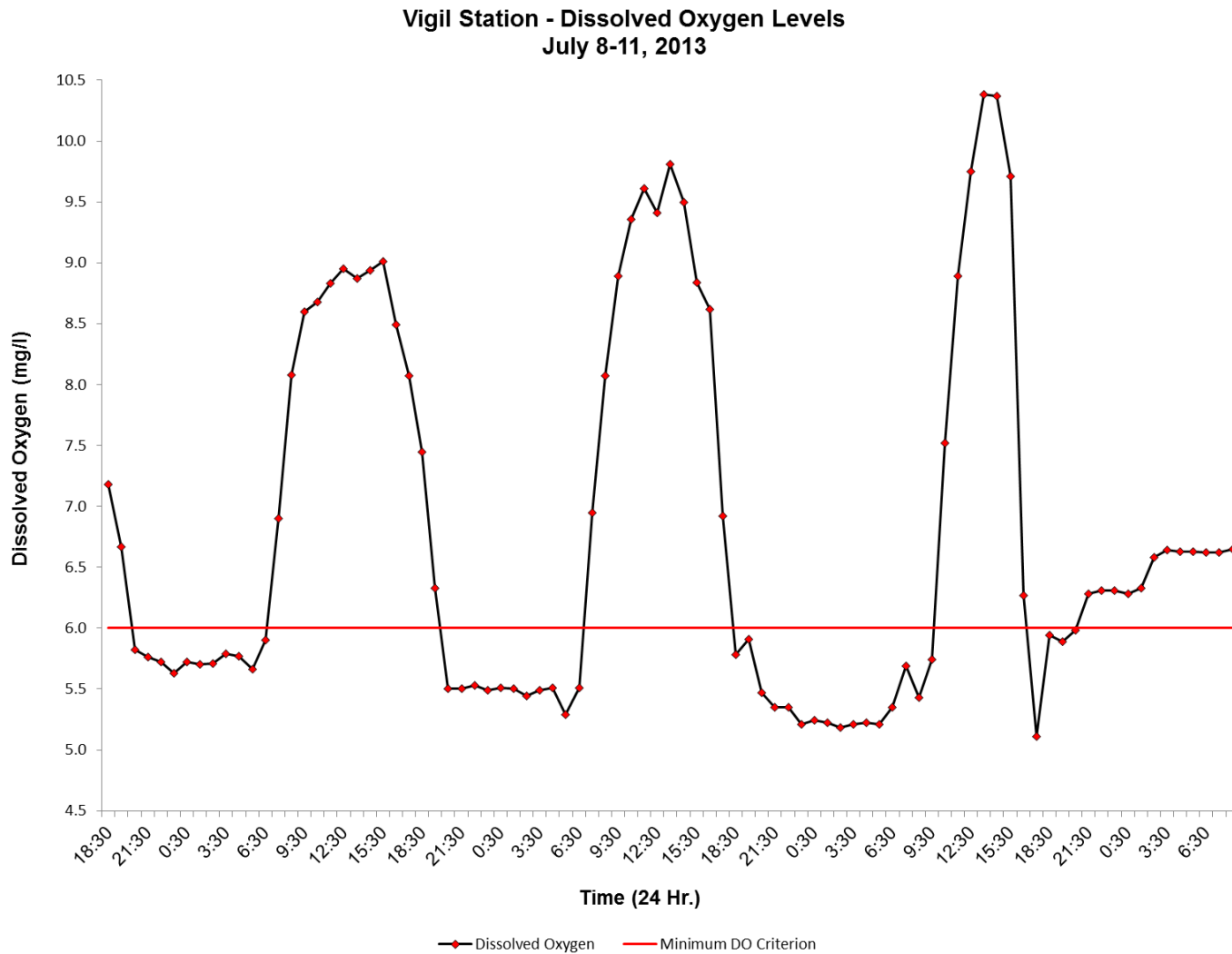
Rio Ruidoso Monitoring Program Conclusions

- New WWTP greatly reduced nutrient concentrations
 - Effluent TP was 1.3 to 3.4 mg/L, now <0.1 mg/L
 - Downstream TP was up to 0.95 mg/L, now mostly <0.1
 - Effluent dilutes Rio Ruidoso TP
 - Effluent TN was 4.3 to 28.7 mg/L, now 0.55 to 5.5 mg/L
 - Downstream TN was 1.0 to 5.7 mg/L, now mostly <1.0
 - Other sources make TN <1.0 mg/L in river difficult to achieve
- Level I nutrient assessment: non-impairment
- Level II nutrient assessment: impaired, DO improving but did not meet all thresholds

Revisiting Nutrient Impairment in 2013

- 303(d) list to be updated late this year
- July 2013 monitoring
 - Macro-algae coverage was back >50% after 10 months
 - DO below 6.0 mg/L and 90% saturation, also >120% saturation
 - DO diel fluctuation >3.0 mg/L
- No potential for de-listing this year

Revisiting Nutrient Impairment



Nutrient Compliance – What Lies Ahead?

- Schedule set by August 2012 NPDES Permit
 - 4.0/6.0 mg/L TN interim technology-based limits
 - Establish new TN control limits in 3 years, if needed
 - Otherwise attain 1.0 mg/L final TN limit in 5 years (2017)
- 2014 TMDL Update
- 2015 NPDES Permit Update

Nutrient Compliance – What Lies Ahead?

- Nutrient TMDL issues
 - Average upstream concentration
 - Critical low flows for determining waste load allocations
 - What is the appropriate low flow statistic?
 - Where is it applied?
 - Bioavailability, use of N:P ratio to determine TN target concentration
- Technology-based effluent limits and alternative effluent limits (consider economics) are under development for narrative standards (TN)
- Wastewater re-use may be more economical

Concluding Thoughts

- Where WWTP effluent discharge is a major component of receiving water flows:
 - TN target concentrations may be very challenging
 - This may drive communities to wastewater re-use
- Critical low flow not based on nuisance algae growth
- Technical work groups are developing interim limits:
 - Technology-based limits
 - Alternative limits that consider economics
 - Compliance schedules up to 20 years
- Ruidoso compliance timeline was accelerated by litigation, but many others may be facing this soon

Questions?

