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Technology Case Studies:
Recirculating Media Filters

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Technology Case Studies: Recirculating Media Filters

- Questions
  - how does the effluent from a packed-bed recirculating media filter respond to diurnal changes in organic loading?
  - does this variation in loading effect the denitrification process?
  - do weekend loadings differ from weekdays in terms of final effluent quality?

Background

- Packed-bed recirculating media filters
  - Two problems with the name
    - the media doesn't recirculate
    - and the process does not filter
- Common process for small-system wastewater treatment
  - passive aeration
  - low maintenance
  - larger footprint
  - withstands shock loadings

Packed-Bed Media Biological Reactor

Biological Treatment

- Using microbes to renovate wastewater
- Primary goals
  - reduction of organic carbon
    - BOD biochemical oxygen demand
  - nitrification and denitrification
    - reduce nitrate discharge
    - public and environmental health issue
  - reduction of pathogens
  - reduction of total solids content

Based on Trickling Filter Technology

However, There are Big Differences

- Trickling filter
  - high flow rate per surface area & deep
  - large pores between media particles
  - generation of biosolids, which must be collected
- Packed-bed recirculating media filter
  - low flow rate per surface area & shallow
  - small media particles, small pores
  - slow build-up of biosolids

Investigated System

- Blount County, Tennessee
- Subdivision
  - STEG
  - approximately 80 homes
    - three bedroom pre-manufactured housing

Wastewater Infrastructure

- Lift station
  - collects all the water from STEG
  - transfers water to recirculating packed-bed media filter
- Hines-Pickney sand filter
  - 30,000 gallon per day
  - volume moved through filter is approximately five times the daily inflow
- Subsurface drip irrigation dispersal

Specifications

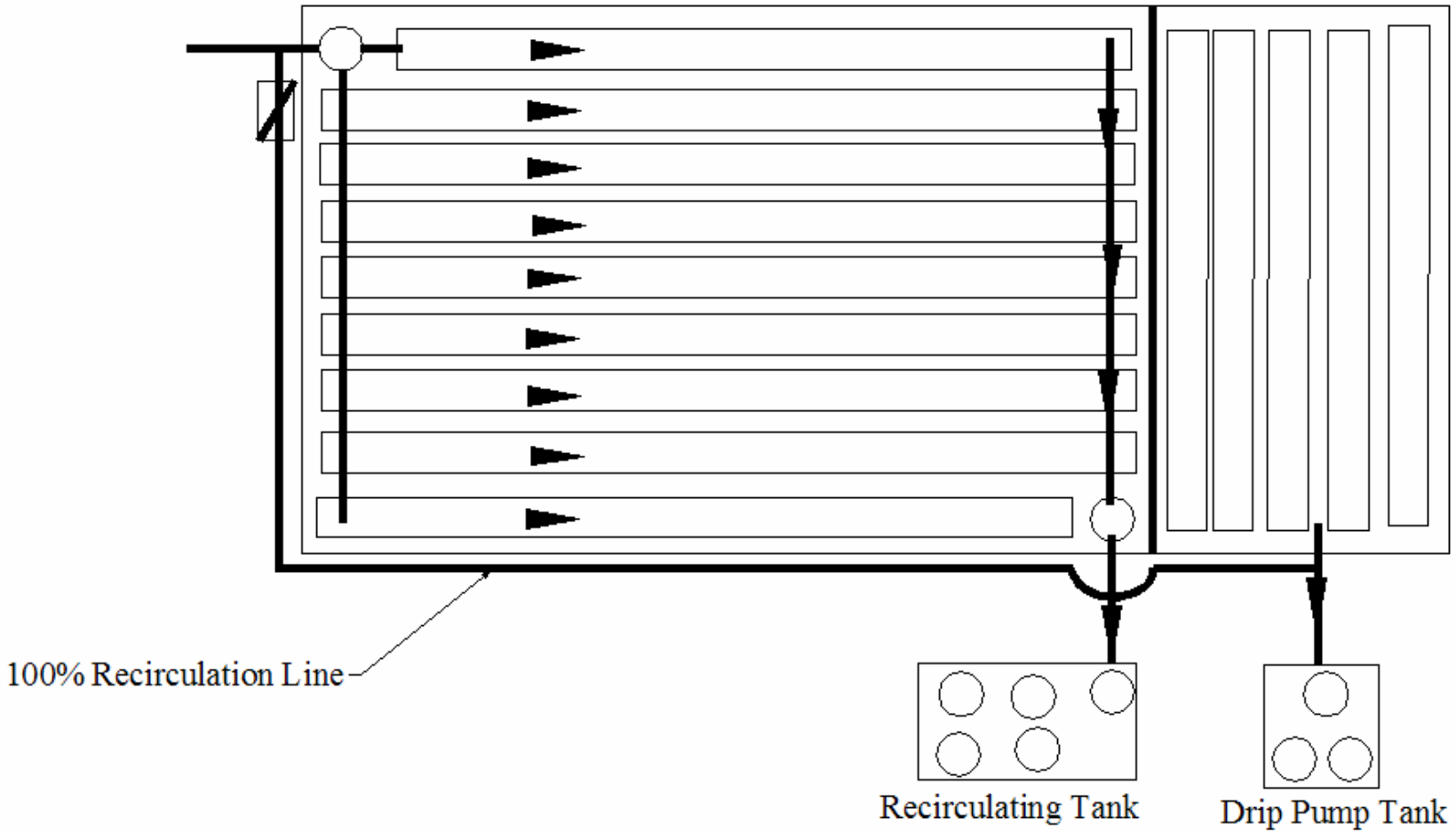
- 6,000 square feet of top surface area
  - 5 gallons per day per square foot
- 4 feet deep
  - bottom layer – 12” of open vaults
  - transition layer – 6” larger gravel
  - treatment media – 24” of fine gravel
  - cap over distribution laterals – 6” larger gravel

Specifications

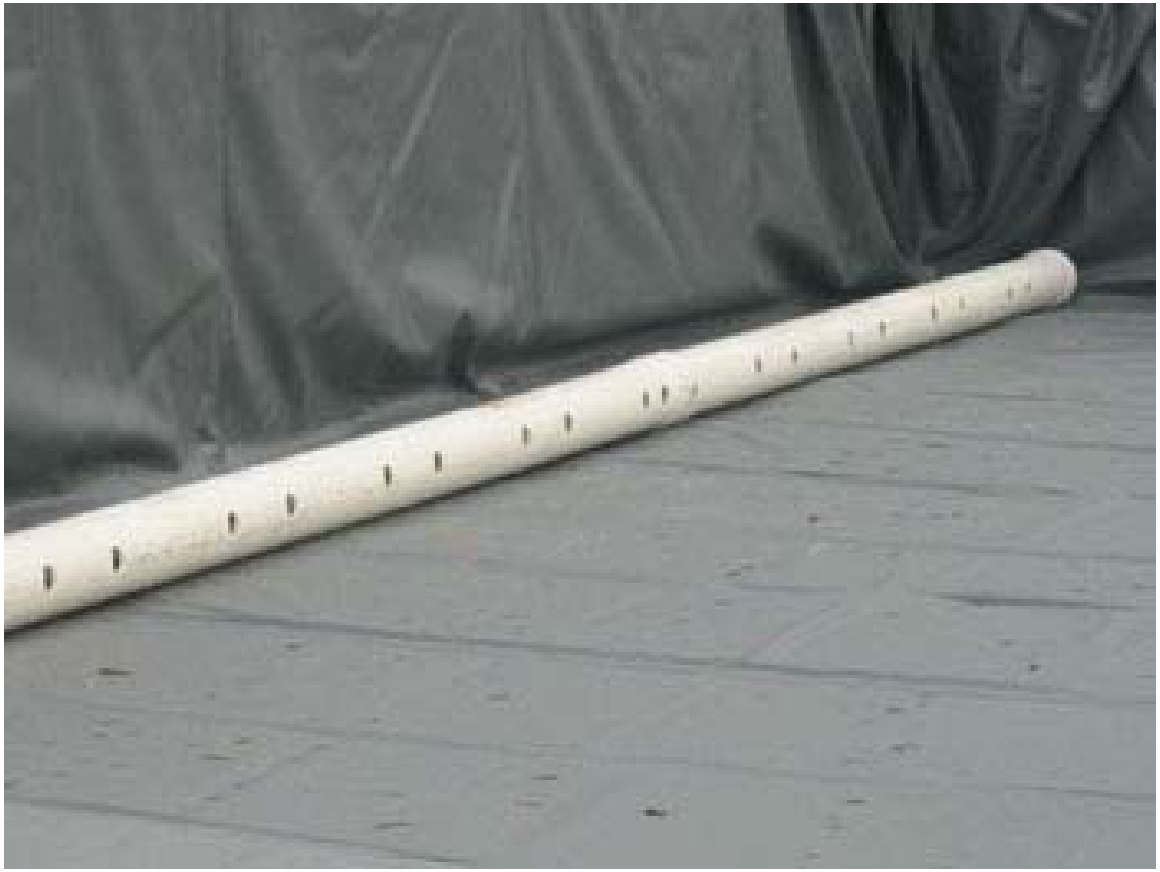
- Effluent distribution across top of media
  - low pressure system with orifices on 15” by 15” centers
  - five major zones, with 4 zones within major zones
- Recirculation and final pass
  - four zones recirculates
  - fifth zone drains to drip system dose tank

Liner and Divider Wall

Typical Flow Diagram



Distribution Pipe



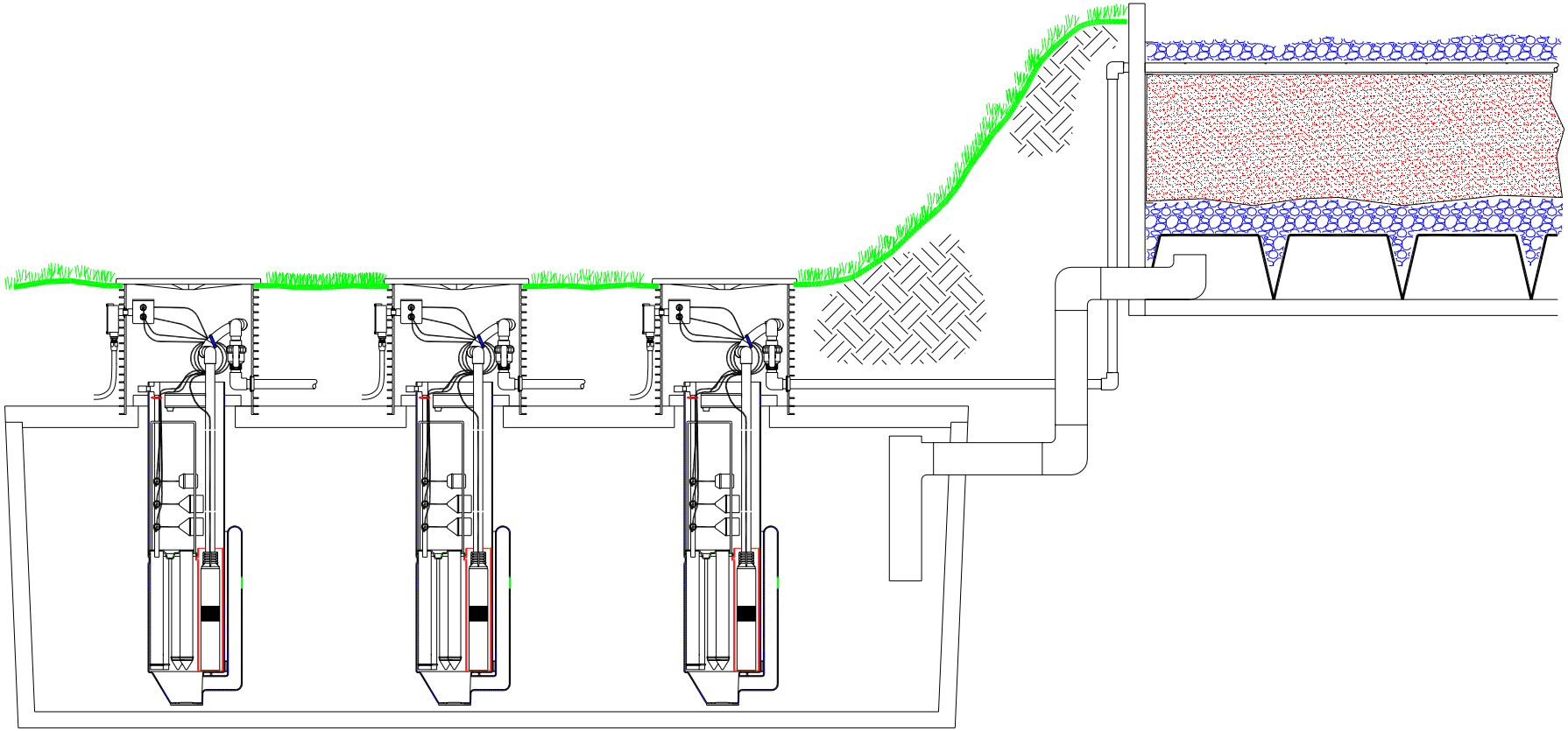
Chambers for Open Storage Beneath Media

Gravel over Chambers
Media over Gravel

Media Cap and Distribution Laterals

Recirculation Tanks and Dose Tanks

Recirculation Tank and Media Filter



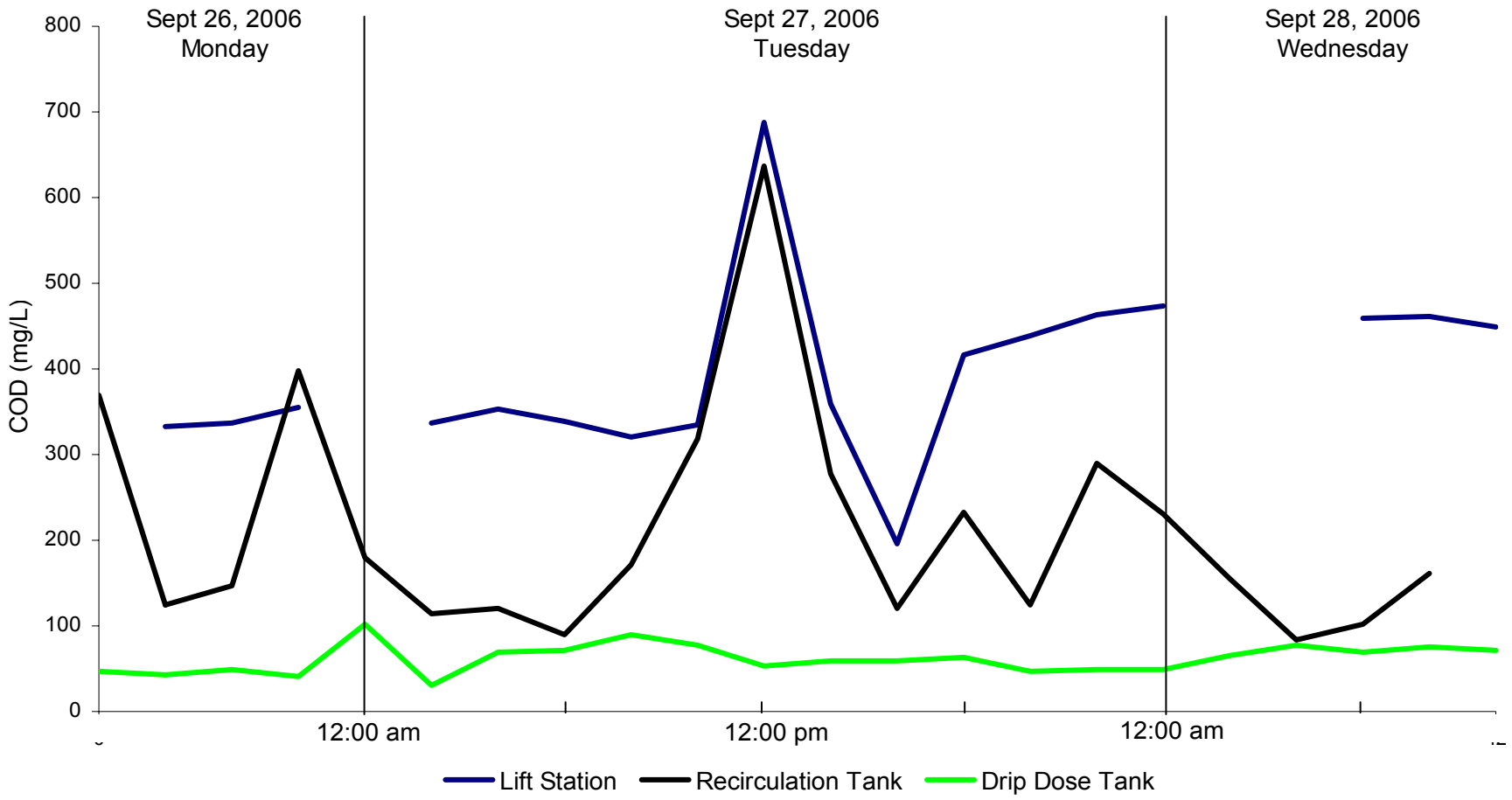
Treatment Capabilities

Question: Does diurnal variation of influent produce diurnal variation in final effluent ?

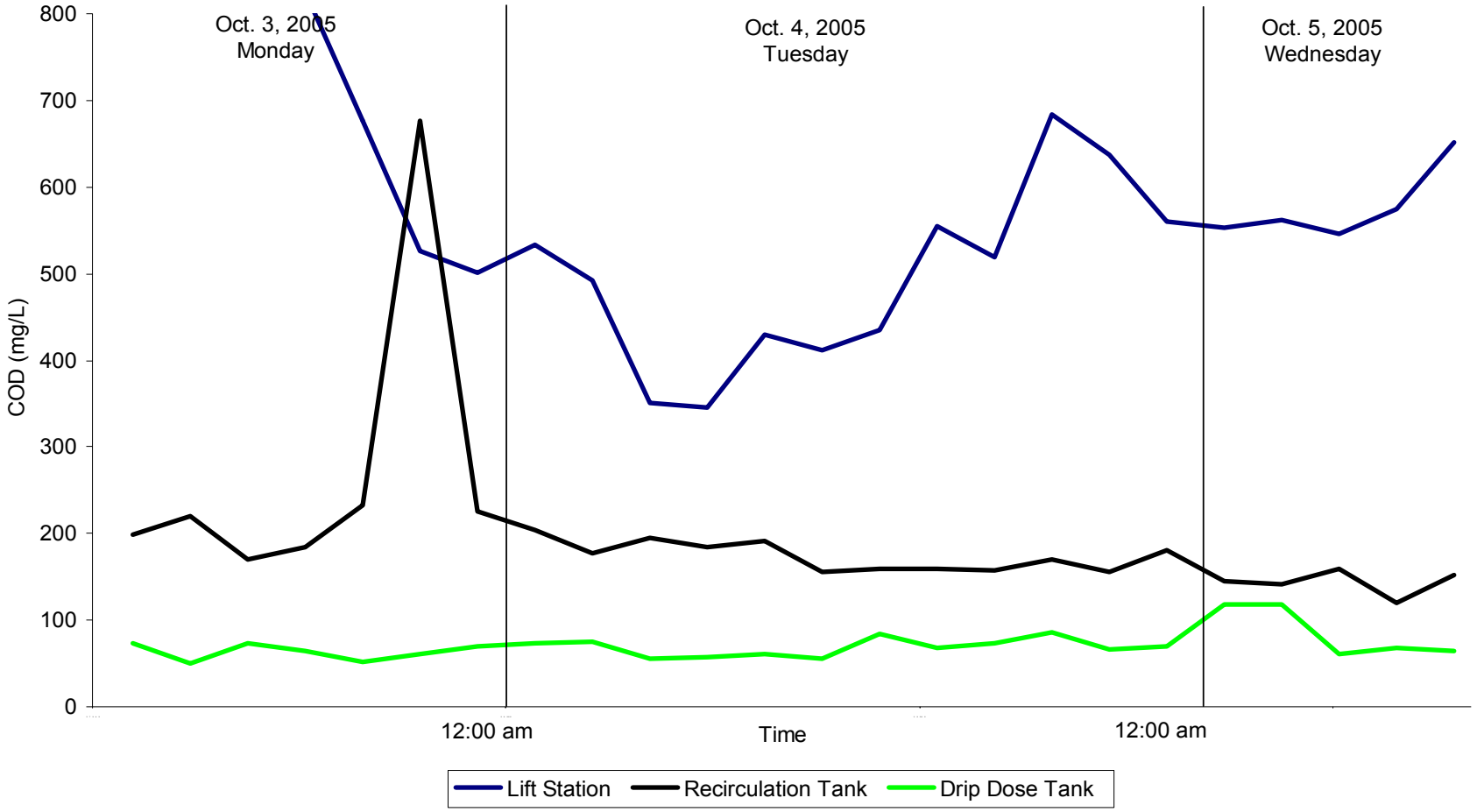
Sampling

- ISCO automatic samplers
  - programmed to take a 750 ml sample every two hours
  - can hold 24 samples, thus two days
- Three samplers
  - lift station tank
  - recirculation tank
  - drip dose tank

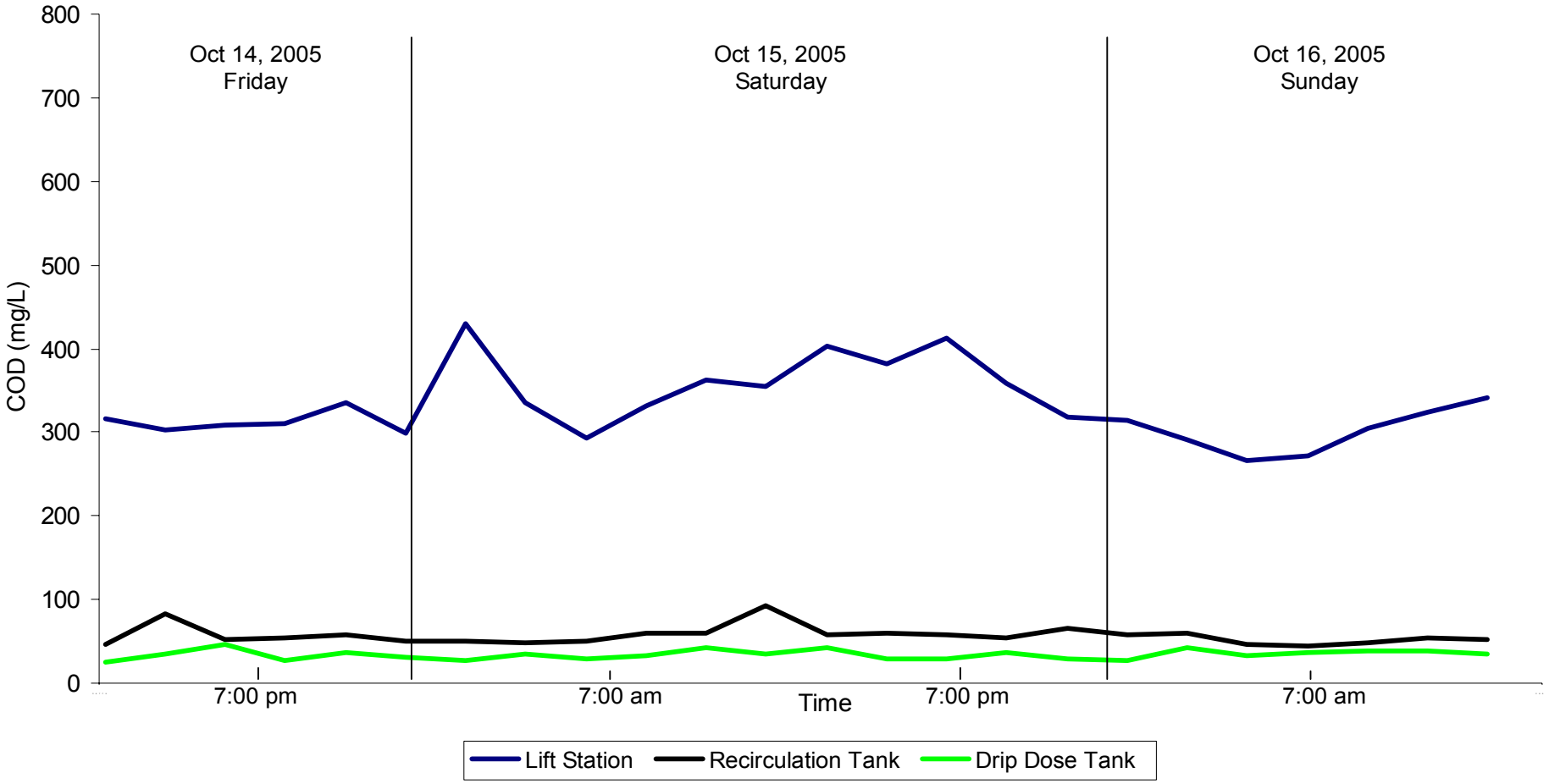
COD and Time (1st Set)



COD and Time (2nd Set)

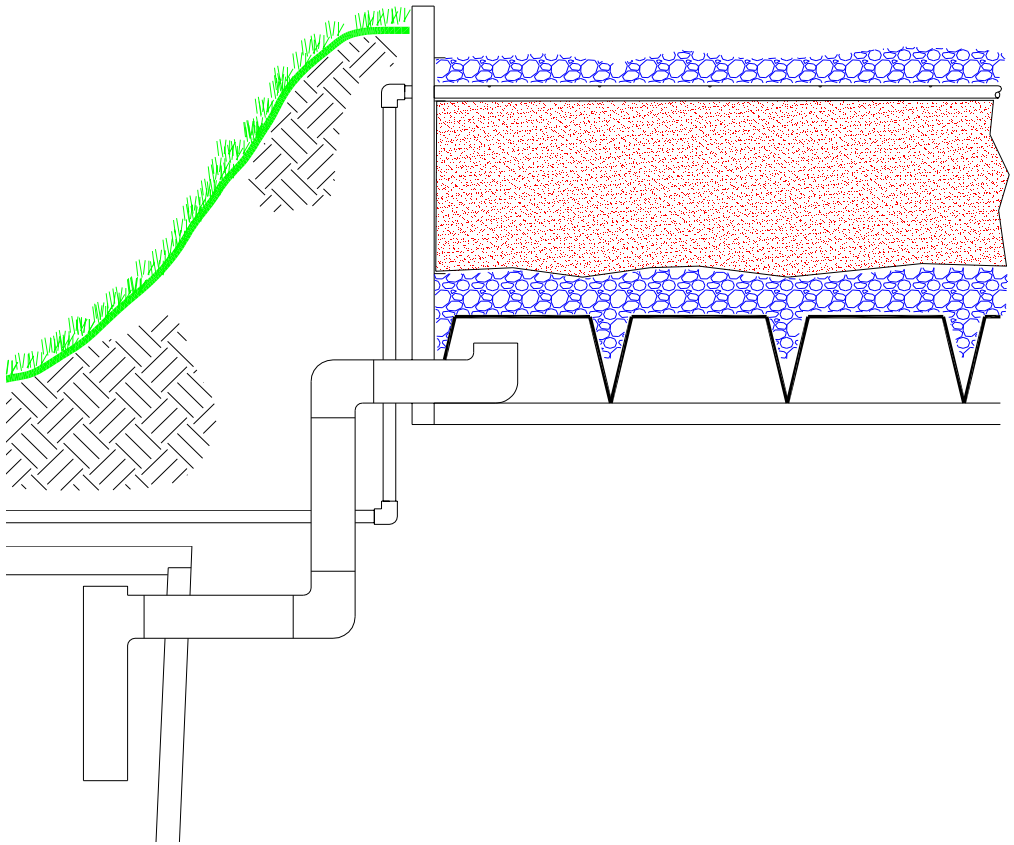


COD and Time (Weekend)

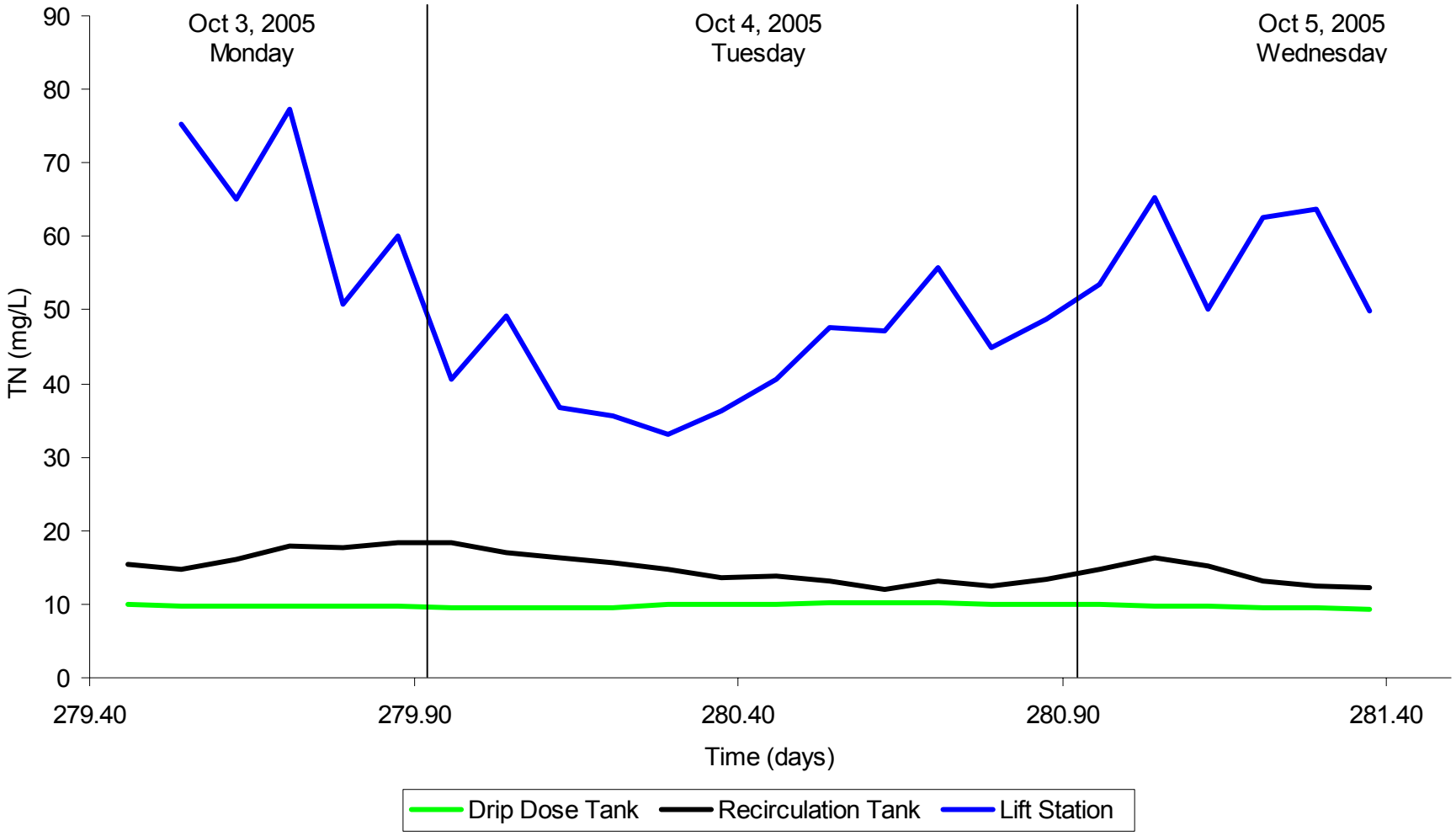


For Nitrogen Removal…

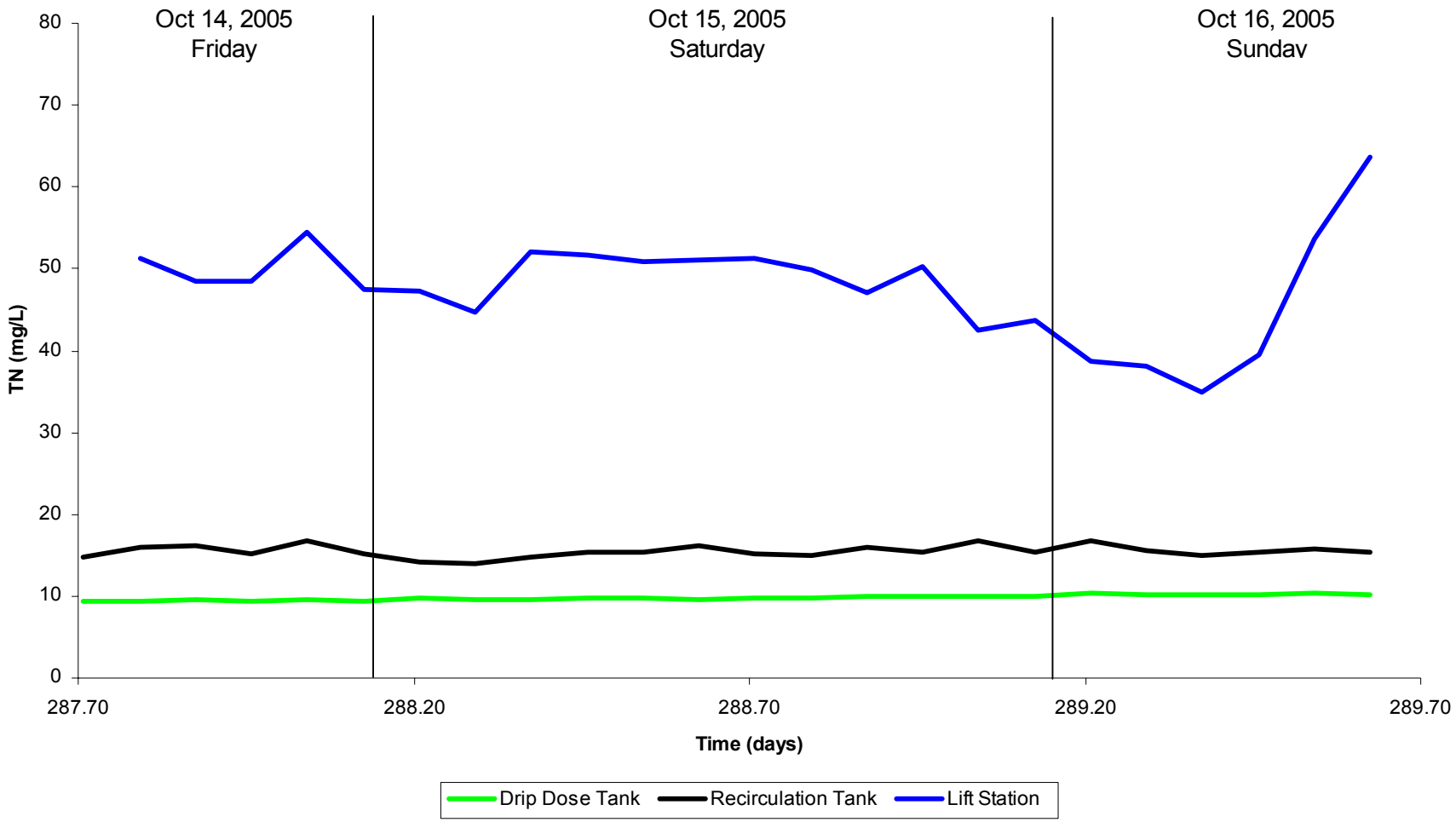
- Need aerobic conditions for nitrification and anaerobic conditions for denitrification



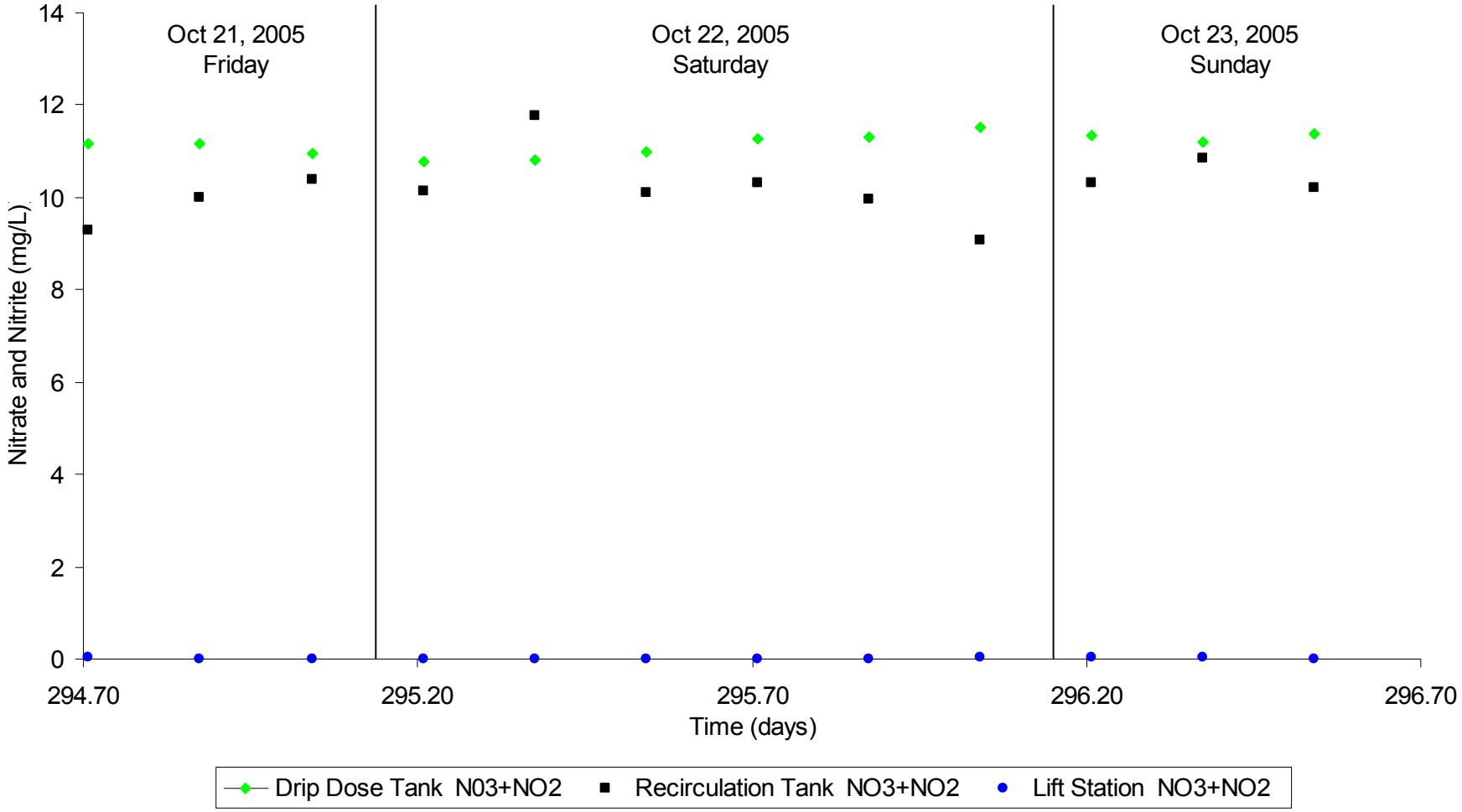
Nitrogen Removal (TN)



Total Nitrogen and Time (Weekend)



Nitrification and Denitrification



Preliminary Conclusions

- Sufficient buffering and mixing within system to handle variations in influent strength to produce very constant effluent
- Nitrification was not really a question
- Denitrification is occurring
  - can it be optimized?

Next Phase

- Measure dissolved oxygen at various locations
  - does the recirculation tank maintain anaerobic conditions?
    - with all the recirculation, is the organic strength high enough to consume the D.O.?
  - could recirculation be suspended during low flows to allow more denitrification to take place?
  - at what cost to carbon removal?

Questions and Comments

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