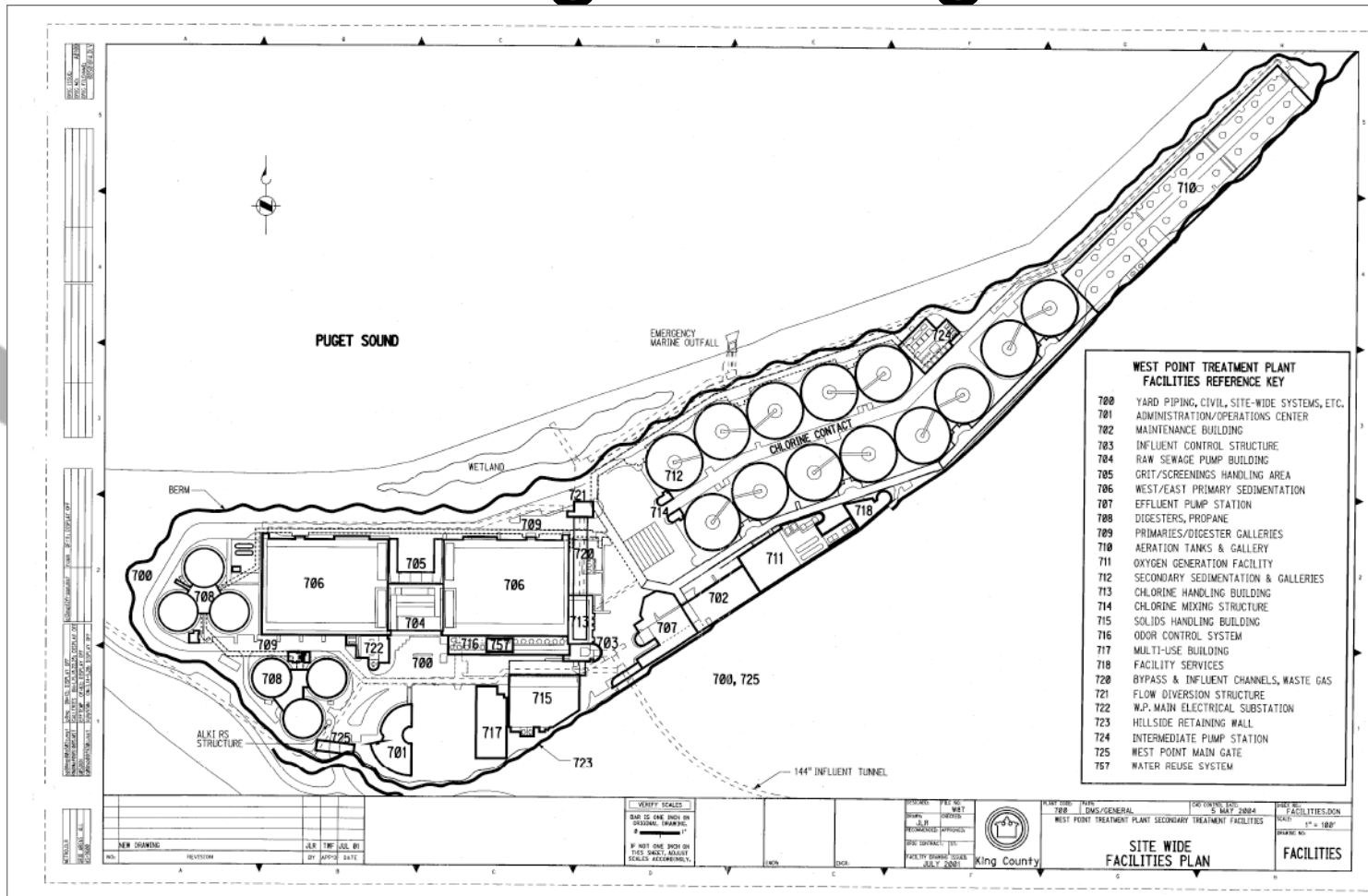


West Point Treatment Plant Engineering



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Lesson #1: Being a consummate engineer means always knowing when to strike a pose.

Miscellaneous Tasks

- Equipment data collection.
- Pump evaluation.
- Project price estimations.
- Assisting CAD drafter.
- Derive and prove 3-D spherical Navier-Stokes Equations.

$$\rho \left(\frac{\partial u_r}{\partial t} + u_r \frac{\partial u_r}{\partial r} + \frac{u_\theta}{r \sin(\phi)} \frac{\partial u_r}{\partial \theta} + \frac{u_\phi}{r} \frac{\partial u_r}{\partial \phi} - \frac{u_\theta^2 + u_\phi^2}{r} \right) = -\frac{\partial p}{\partial r} + \rho g_r$$

$$\mu \left[\frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial u_r}{\partial r} \right) + \frac{1}{r^2 \sin(\phi)^2} \frac{\partial^2 u_r}{\partial \theta^2} + \frac{1}{r^2 \sin(\phi)} \frac{\partial}{\partial \phi} \left(\sin(\phi) \frac{\partial u_r}{\partial \phi} \right) - 2 \frac{u_r + \frac{\partial u_\phi}{\partial \phi} + u_\phi \cot(\phi)}{r^2} + \frac{2}{r^2 \sin(\phi)} \frac{\partial u_\theta}{\partial \theta} \right]$$

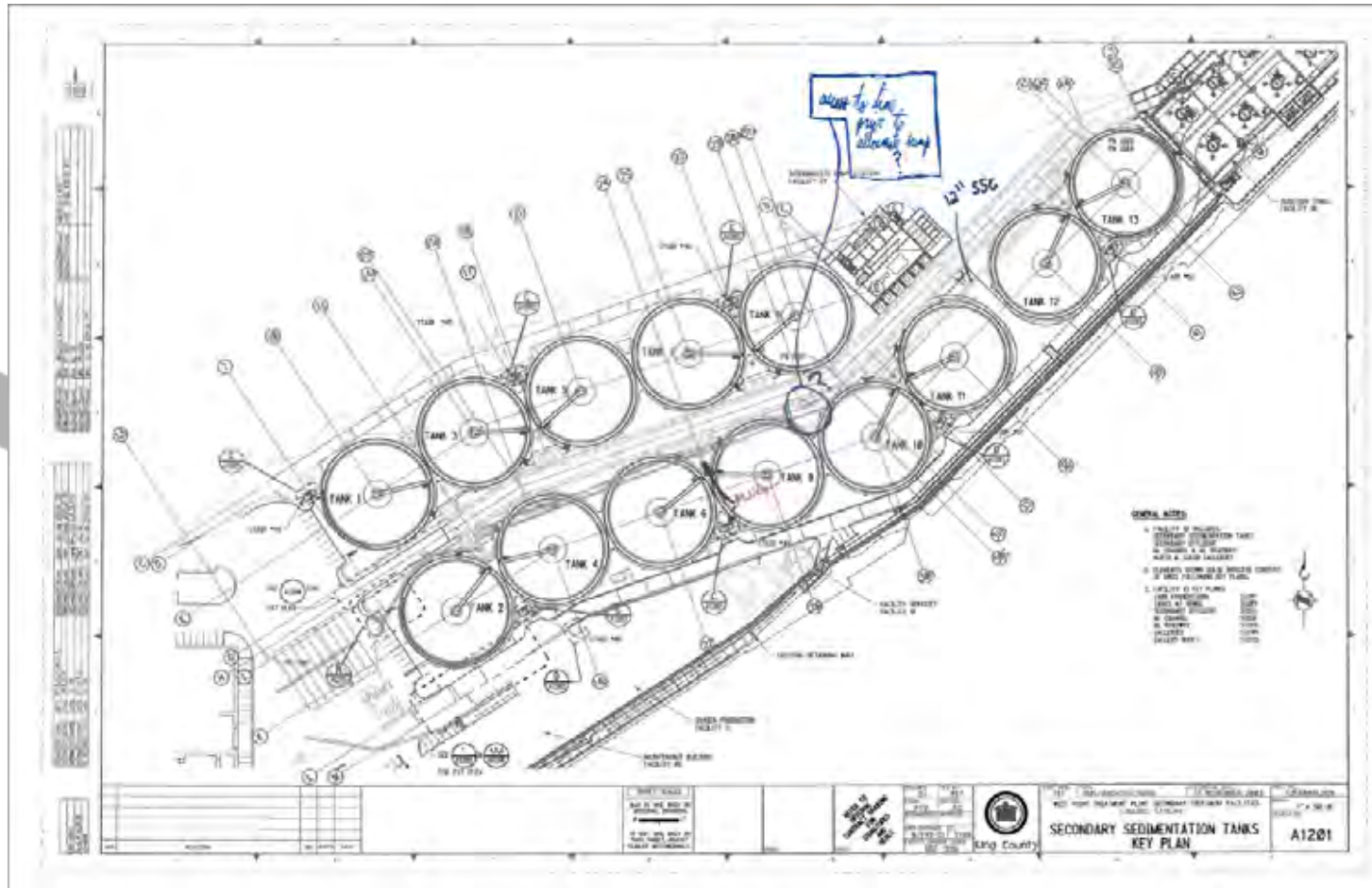
$$\rho \left(\frac{\partial u_\theta}{\partial t} + u_r \frac{\partial u_\theta}{\partial r} + \frac{u_\theta}{r \sin(\phi)} \frac{\partial u_\theta}{\partial \theta} + \frac{u_\phi}{r} \frac{\partial u_\theta}{\partial \phi} + \frac{u_r u_\theta + u_\theta u_\phi \cot(\phi)}{r} \right) = -\frac{1}{r \sin(\phi)} \frac{\partial p}{\partial \theta} + \rho g_\theta$$

$$\mu \left[\frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial u_\theta}{\partial r} \right) + \frac{1}{r^2 \sin(\phi)^2} \frac{\partial^2 u_\theta}{\partial \theta^2} + \frac{1}{r^2 \sin(\phi)} \frac{\partial}{\partial \phi} \left(\sin(\phi) \frac{\partial u_\theta}{\partial \phi} \right) + \frac{2 \frac{\partial u_r}{\partial \theta} + 2 \cos(\phi) \frac{\partial u_\phi}{\partial \theta} - u_\theta}{r^2 \sin(\phi)^2} \right]$$

$$\rho \left(\frac{\partial u_\phi}{\partial t} + u_r \frac{\partial u_\phi}{\partial r} + \frac{u_\theta}{r \sin(\phi)} \frac{\partial u_\phi}{\partial \theta} + \frac{u_\phi}{r} \frac{\partial u_\phi}{\partial \phi} + \frac{u_r u_\phi - u_\theta^2 \cot(\phi)}{r} \right) = -\frac{1}{r} \frac{\partial p}{\partial \phi} + \rho g_\phi$$

$$\mu \left[\frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial u_\phi}{\partial r} \right) + \frac{1}{r^2 \sin(\phi)^2} \frac{\partial^2 u_\phi}{\partial \theta^2} + \frac{1}{r^2 \sin(\phi)} \frac{\partial}{\partial \phi} \left(\sin(\phi) \frac{\partial u_\phi}{\partial \phi} \right) + \frac{2}{r^2} \frac{\partial u_r}{\partial \phi} - \frac{u_\phi + 2 \cos(\phi) \frac{\partial u_\theta}{\partial \theta}}{r^2 \sin(\phi)^2} \right]$$

6-8 Sump Plug



Clarifier Sumps



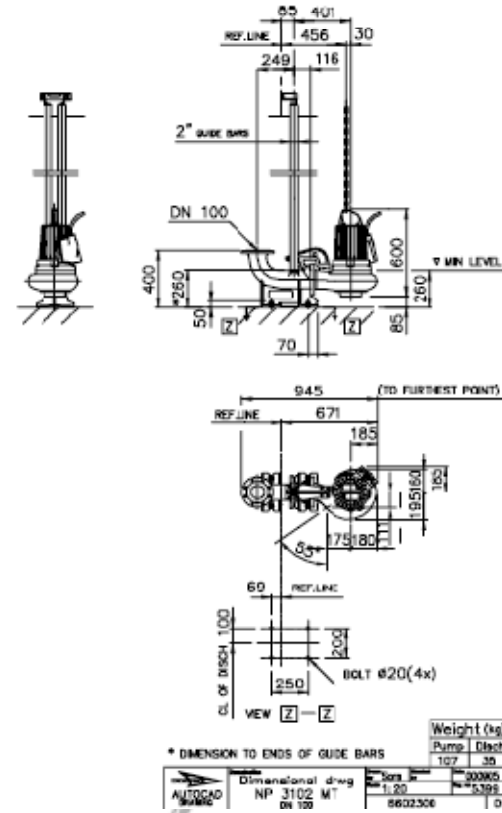
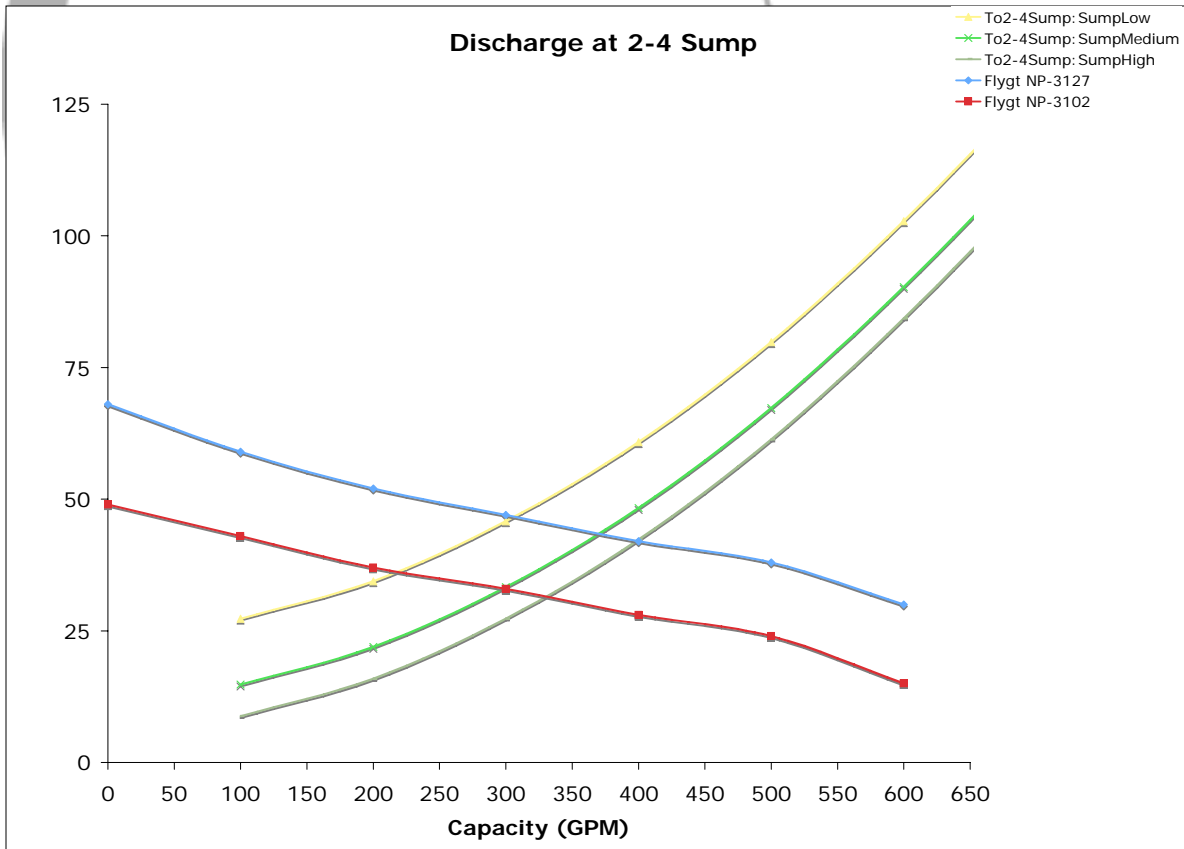
- 25' deep, 6' diameter, serves two sed. tanks.
- 12" drain line blocked for sandblasting.

Current Condition



- 600ft. into main drain line.
- Obscured in sump by two 90 degree bends.
- Previous attempts at physical removal were unsuccessful. Note cable strands.

Pump Solution



Preliminary Cost Estimate: >\$40,000

Chemical Dissolution

- Dissolving Rubber: Aromatic hydrocarbons such as Toluene and Benzene.
- Concentrated Sulfuric Acid.
- Condition of Pipe.
- Chemical Properties of Aluminum: Amphoterism, Relative Reactivity.
- 25% w/w NaOH.
- Lab testing for feasibility.

Laboratory Testing



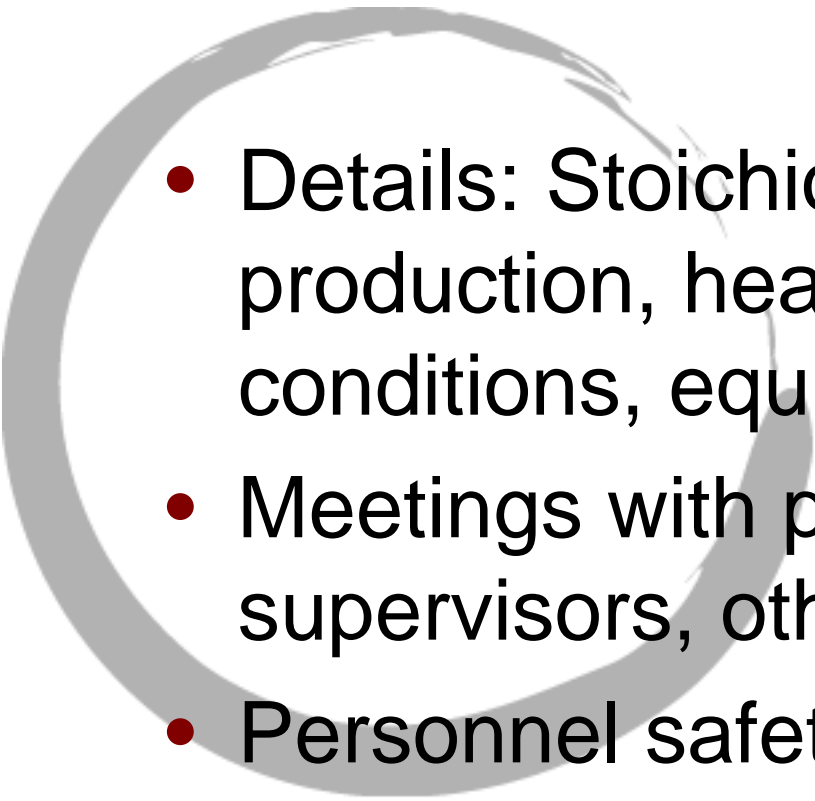
~3 Hours of Chemical Contact



- Considerable pitting of aluminum.
- Ferrous handle unharmed.
- Gas and heat generation.

~23 Hours



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- Details: Stoichiometry, hydrogen gas production, heat generation, process conditions, equipment materials.
 - Meetings with plant manager, supervisors, other staff to gain approval.
 - Personnel safety.
 - Equipment outage.
 - Preparation of procedure detailing responsibilities of various plant staff.
 - Currently scheduled for 8/20/08.
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