Treatment and Biosolids Technologies

City of Morro Bay

New Water Reclamation Facility

Engineering Component of Siting Study

- Project engineering team will look at the following parameters related to each site:
  - Range of cost for conveyance, treatment, and distribution to potential users
  - Land availability for range of treatment and biosolids management options
- A range of treatment technologies can reach City objectives
  - Keep options open during preliminary planning

Public Workshop Results
Top-Ranked Issues from Dot Exercise

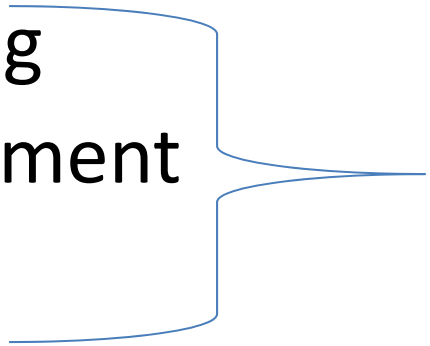
- Environmental
  - Avoid Visual Impacts
- Cost Issues
  - Keep Costs Low (highest score)
- Engineering and Design
  - Recharge Morro Aquifer

Overview

- Environmental
  - Effluent reuse goals – Quality and Quantity
  - Conveyance methods for recycled water
- Cost Issues / Engineering and Design
  - Liquid treatment technologies
  - Biosolids processing technologies / products
  - Procurement

Treatment Processes

- Preliminary – Screening of large solids
- Primary – Flotation & settling
- Secondary – Biological Treatment
- Tertiary – Filtration
- Disinfection
- Advanced
  - Salts
  - Contaminants of Emerging Concern



Treatment Process Selection Driven by End Goals

1. Start with effluent reuse goals
2. Identify treatment technologies to meet those goals
3. Develop plan for handling biosolids from range of liquid treatment options

Effluent Reuse Goals - Quantity

- “How much” varies seasonally
- Evapotranspiration rates determine potential use for irrigation
- Wet weather or production of “off-spec” water often require storage or discharge

Effluent Reuse Goals - Quality

- Regulations drive need for filtration and disinfection
- Public perception can affect usage for food crops
- Sodium, chlorides, and other salts can affect soil permeability and turf/grasses, and crop production

Effluent Reuse Requirements

Usage	Required Level of Treatment[1]
Unrestricted Landscape Irrigation (parks, playgrounds)	Tertiary + Disinfection
Agricultural Irrigation - contact with edible portion of crop	Tertiary + Disinfection
Agricultural Irrigation – edible portion above ground & no contact with recycled water	Secondary + Disinfection
Restricted Landscape Irrigation (freeways, restricted access golf courses, fodder, ornamental nurseries)	Secondary + Disinfection

[1] Certain crops and landscape plants may be sensitive to salts. Advanced treatment (salts removal) may be required for reuse.

Delivery Methods – Creeks/Waterways

- Likely to be considered discharges
- Aquatic toxicity can require treatment for denitrification, disinfection byproducts, temperature, and trace metals
- New inland surface water discharges strongly discouraged by RWQCB
- Facilities
  - Additional treatment processes
  - Outfall with diffusers/mixing zones

Delivery Methods – Aquifer Storage/ Recovery

- Requires ideal subsurface conditions to store/recover groundwater ("deep bowl")
- Proximity to potable water wells (less than 6 months travel time) require reverse osmosis and blending with potable water supplies
- Facilities
  - Transmission pipeline
  - Percolation facilities and manifolds
  - Extraction wellfields
  - Additional treatment facilities (possibly)

Delivery Methods – Pipelines

- Most conventional approach for conveying recycled water
- Fewer regulatory requirements
- Can control water quality and delivery
- Facilities
  - Pumps and tanks
  - Pipelines
  - Retrofit of existing irrigation systems

Secondary Treatment – Technologies and Examples

- Treatment Ponds
  - Adaptive Integrated Wastewater Pond System (AIPS or AIWPS)
  - Aerobic or Facultative Lagoons
- Extended Aeration Activated Sludge
  - Oxidation Ditch
  - Biolac
- Conventional Activated Sludge
  - Plug Flow
  - Sequencing Batch Reactor
- Trickling Filter
- Membrane Bioreactors (Secondary + Tertiary)

Ponds

- Conventional Facultative Lagoons
- Advanced Integrated Wastewater Ponds

Footprint	9 to 12 AC
Cost*	$10 to $15+ M depending on earthwork costs

AIWPS in Dehli, CA

* Costs include construction of primary & secondary liquid treatment only

Extended Aeration Activated Sludge

- Biolac®
- Oxidation Ditches

Footprint	2.5 to 4.0 AC
Cost*	$6 to $15 M

* Costs include construction of primary & secondary liquid treatment only

Conventional Activated Sludge

- Plug-flow
- Sequencing Batch Reactor (SBR)

Footprint	0.75 to 1.25 AC
Cost*	$9 to $13 M

* Costs include construction of primary & secondary liquid treatment only

Trickling Filter

Footprint	5.0 to 6.5 AC
Cost*	$16 to $21 M

Membrane Bioreactors (MBR)

Footprint	0.75 to 1.25 AC
Cost*	$20 to $30 M

* Costs include construction of primary & secondary liquid treatment only

Filtration

- Disk Filters
- Sand/Media Filters

Footprint	0.01 to 0.03 AC
Cost*	$2 to $3 M

* Costs include construction of filtration systems only

Disinfection

- Chlorination
- Ozone
- Ultraviolet (UV) Lamps

Footprint	0.25 to 0.5 AC
Cost*	$1.5 to $3 M

* Costs include construction of disinfection systems only

Advanced Treatment – Salts Removal

- Ex: Reverse Osmosis

Footprint	0.2 AC
Cost*	$7 to 10M

* Costs include construction of reverse osmosis systems only. Does not include brine disposal.

Summary of Space and Cost Requirements

Technology	Footprint	Capital Cost
Ponds	9 to 12 AC	$10 to $15+M
Extended Aeration Activated Sludge	2.5 to 4 AC	$6 to $12M
Conventional Activated Sludge	0.75 to 1.25 AC	$11 to $15M
Membrane Bioreactor	0.75 to 1.25 AC	$25 to $30M (includes filtration so not just secondary treatment)

Note: Costs do not include screening, sitework, disinfection or effluent disposal /reuse costs. Intended only as a comparison between secondary treatment stages.

Additional Siting Concerns and Mitigation Measures

- Odor
  - Process selection
  - Cover basins and collect/treat gases
- Visibility
  - Screening
  - Architectural treatments
- Power availability
- Other utilities (water, communications, etc.)
- Solar panels (?)

Ranking

Technology	Low Capital Cost	Low Energy Usage	Low O&M Cost	Ease of Operation	Water Quality for Reuse
Ponds	4	4	1	1	4
Extended Aeration Activated Sludge	2	3	2	2	2
Activated Sludge	1	1	3	2	2
Membrane Bioreactor	3	2	4	4	1

1 = Top Ranked

Ranking (Including Filtration)

Technology	Low Capital Cost	Low Energy Usage	Low O&M Cost	Ease of Operation	Water Quality for Reuse
Extended Aeration Activated Sludge with Filters	2	3	1	1	Similar
Activated Sludge with Filters	1	1	2	2	Similar
Membrane Bioreactor	3	2	3	3	Similar

1 = Top Ranked

Biosolids

- Influent Screenings
  - Go to landfill
  - No significant energy recovery potential
- Primary and Secondary Biosolids
  - From primary clarification and secondary treatment processes
  - Energy recovery potential
  - High volume – very wet (98-99+% water)
- Tertiary Treatment Solids
  - Minor quantities
  - Inert – little energy recovery potential

Biosolids Treatment – Goals

- End Products – Beneficial reuse
  - Compost
  - Fertilizer pellets
  - Energy / Inert materials (Ash)
- Disposal Methods
  - Landfill
  - Land Disposal

Biosolids Treatment – Land Application Requirements

- Class B – Can go to some landfills or for composting
  - Dewatered
  - Heated at over 40 deg C for 5 days
- Class A / Exceptional Quality – Can be land-applied (exception – limits in SLO County)
  - Dewatered
  - Heated at over 55 deg C for 3 days
  - EQ meets state metals req’ts

Biosolids – Delivery Methods to Disposal Facilities/End Users

- Hauling
  - City
  - End users (ex. Composting program)
- Pipelines
  - Very dilute sludge

Biosolids Treatment

- Thickening – Removing water without creating sludge “cake” (3 to 6% dry solids)
- Dewatering – Removing water and creating a low-volume “cake” (20 to 50% dry solids)

Thickening

- Gravity Thickener

- Dissolved Air Flotation

- Gravity Belt Thickener (GBT)

Thickening (Cont'd)

- Rotary Drum Thickener

- Screw Thickener

Footprint	0.01 to 0.15 AC
Cost	$0.5M to $1.0M

Dewatering

- Drying Beds

Drying Beds

- Belt Filter Press

Dewatering

- Screw Press

- Centrifuge

Footprint	0.02 to 2.0 AC
Cost	$1.0M to $2.0M

Digestion

- Aerobic Digester

Footprint	0.2 to 0.3 AC
Cost	$3.0M to $4.0M

- Anaerobic Digester – often coupled with energy recovery

Composting

- Windrow at MBCSD

Footprint	0.5 to 1.0 AC
Cost	$1.0M to $1.5M

Biosolids Treatment “Trains”

Example: Thickening + Digestion + Dewatering

Screw
Thickener

Anaerobic
Digester

Screw Press

Footprint	0.2 to 5 AC
Cost	$5 to $10+ M

Biosolids Reuse

- Composting
  - Requires thickening and/or dewatering first
- Fertilizer
  - Emerging technology
- Energy Recovery
  - Combined head and power generation (“Cogen”) typically performed with anaerobic digesters
  - Gasification = Emerging technology

Siting and Cost Issues

- Aesthetics
  - Odor
  - Visibility
- Hauling and disposal
  - Traffic impacts
  - Cost and traffic impact are proportional to volume
    Better dewatering = less cost/impact

Relevance to Siting Study

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Questions?

Effluent Reuse – Emerging Issues

- Contaminants of Emerging Concern
  - Pharmaceuticals
  - Personal Care Products (PCPs)
- Monitoring protocols under development
- Treatment approaches under development
  - Advanced Treatment
    - Activated carbon + oxidizing chemicals (H2O2, etc.) + UV
    - Reverse osmosis + oxidizing chemicals + UV