WATER FOOTPRINTING
SUGAR BEET PROCESSING

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Water Footprinting

Sugar Beet Processing

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ASSBT Meeting Orlando,FL
February 27, 2009

Overview

- Water Footprint Concepts
- Sugar Beet Processing – Water Balance & Reuse
- Crop Freshwater Requirements
- Overall Balance

Water Footprint Concepts

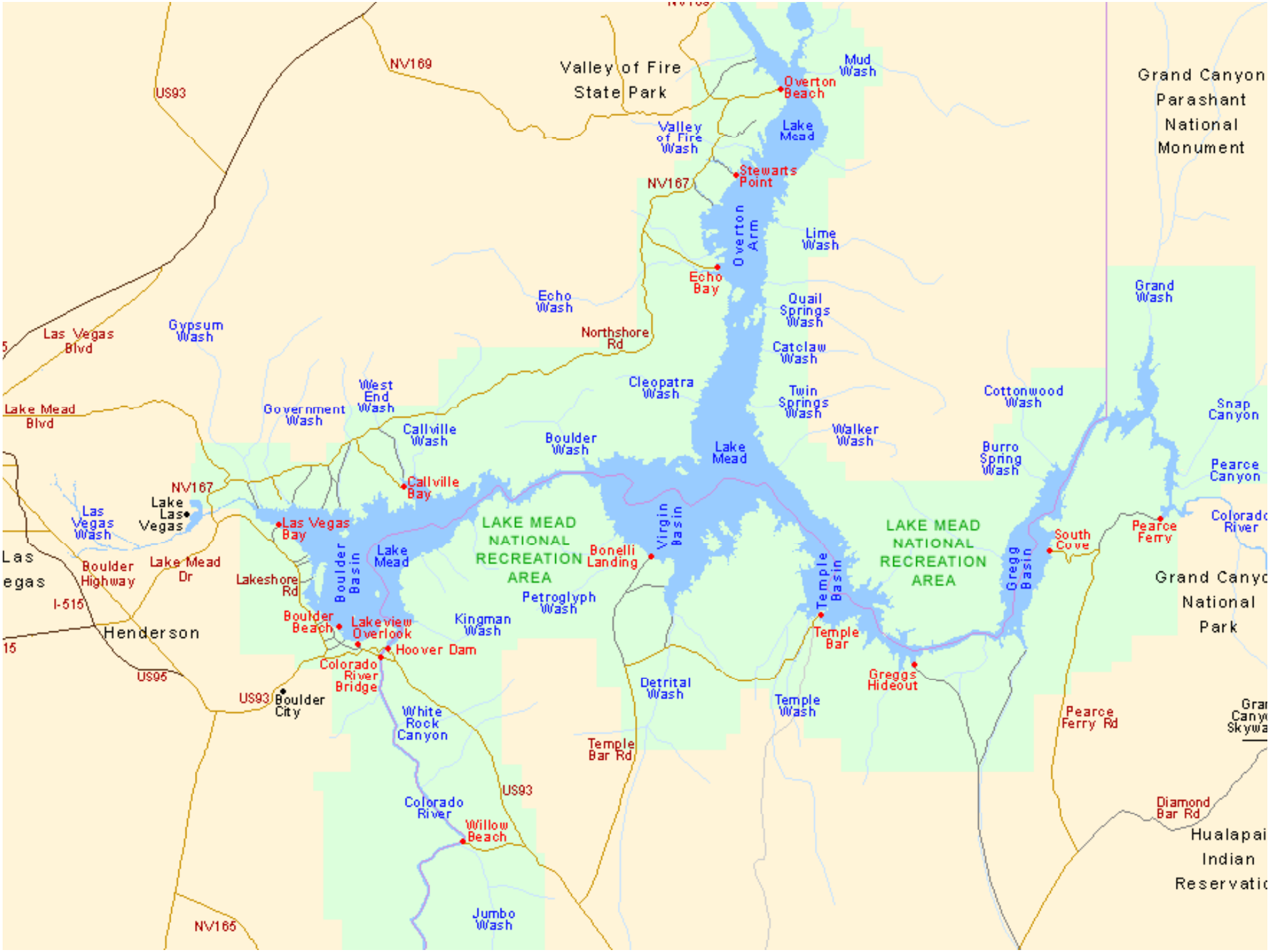
- Freshwater usage by individuals, businesses or communities.
- Industry- The total amount of freshwater (surface water or groundwater) that is consumed to produce a good or service.
- From: www.waterfootprint.org

Why Water Footprints?

- Facing the Freshwater Crisis (Scientific American Article – August 2008)
- Freshwater supplies are declining due to growing populations.
- Increased water usage for: drinking, hygiene, sanitation, food production and industry.

Lake Mead

- Key source of water for millions of people in southwest US (Las Vegas & Los Angeles)
- Largest human made lake located on the Colorado River, formed by the Hoover Dam.
- 118 feet below max levels (46% of capacity)
- Currently holds 28.5 million ac-ft
- Net deficit of 1 million ac-ft/yr


Valley of Fire State Park
NV169
US93
Mud Wash
Overton Beach
Grand Canyon Parashant National Monument
Valley of Fire Wash
Lake Mead
Stewarts Point
NV167
Overton Arm
Lime Wash
Echo Bay
Grand Wash
Echo Wash
Quail Springs Wash
Gypsum Wash
Las Vegas Blvd
Northshore Rd
Catclaw Wash
Cleopatra Wash
West End Wash
Twin Springs Wash
Cottonwood Wash
Snap Canyon
Lake Mead Blvd
Government Wash
Callville Wash
Boulder Wash
Walker Wash
Lake Mead
Burro Spring Wash
Pearce Canyon
NV167
Callville Bay
Lake Las Vegas
Las Vegas Wash
Las Vegas Bay
LAKE MEAD NATIONAL RECREATION AREA
Virgin Basin
Bonelli Landing
LAKE MEAD NATIONAL RECREATION AREA
South Cove
Pearce Ferry
Colorado River
Las Vegas
Boulder Highway
Lake Mead Dr
Boulder Basin
Lake Mead
Gregg Basin
Grand Canyon National Park
Lakeshore Rd
Petroglyph Wash
I-515
Boulder Beach
Lakeview Overlook
Kingman Wash
Temple Basin
Temple Bar
Henderson
Hoover Dam
Colorado River Bridge
US95
US93
Boulder City
Detrital Wash
Greggs Hideout
Temple Wash
White Rock Canyon
Pearce Ferry Rd
Temple Bar Rd
US93
Diamond Bar Rd
Colorado River
Willow Beach
Hualapai Indian Reservation
Jumbo Wash
NV165

Water Footprint Concepts

- Relative new concept.
- Introduced in 2002 by UNESCO-IHE (United Nations Educational, Scientific and Cultural Organization)
- IHE – International Institute for Hydraulic and Environmental Engineering.
- Located in Delft, the Netherlands

The Amalgamated Sugar Co. LLC

Processing Facilities

Processing Facilities

The Amalgamated Sugar Co. LLC

- Three (3) processing facilities located in the cities of Paul, Twin Falls and Nampa.
- Beet Processing Campaign – October thru March.
- Juice Runs – March thru September
- Facilities utilize both surface water and freshwater for beet processing.

Sugar Beet Growing Areas

The Amalgamated Sugar Co. LLC

- Most sugar beets grown in the Snake River Plain in Southern Idaho.
- Classified as a northern desert with annual rainfall amounts of ~10 in/yr.
- Crop Water – Supplied primarily by irrigation canals and well water.

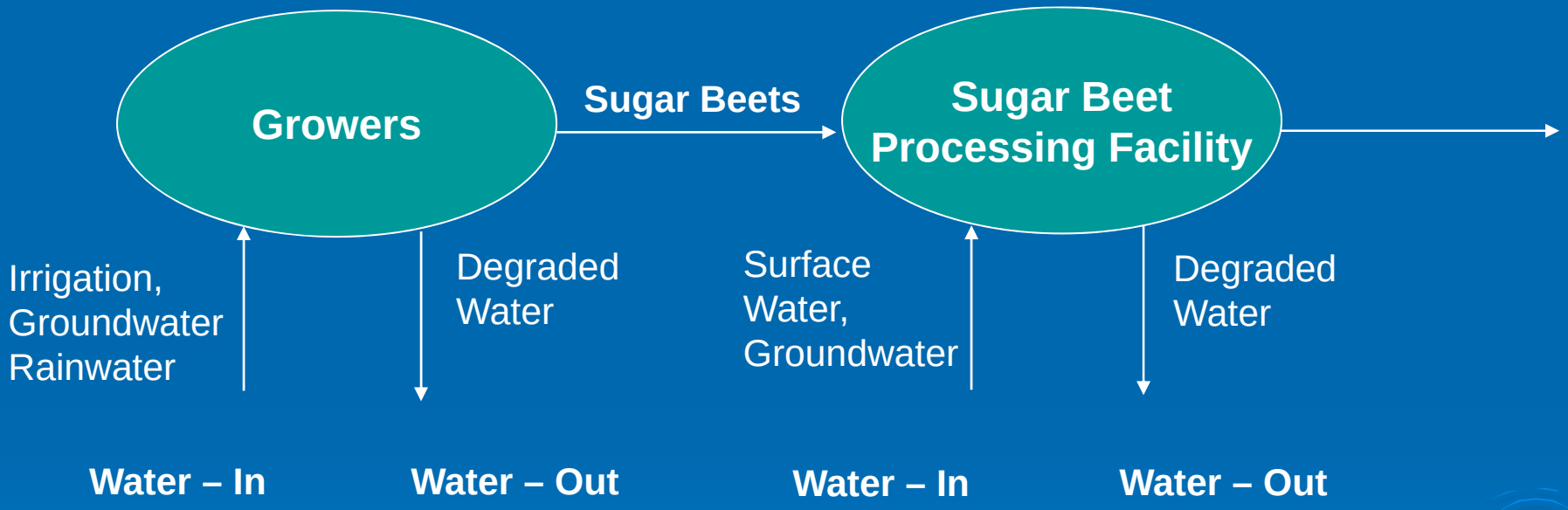

IDAHO
MONTANA
Nyssa
Nampa
Twin Falls
Mini-Cassia
UTAH

General Water Balance

Sugar Beet Growing & Processing

Water Footprint – General Diagram

Growing & Processing of Sugar Beets



Simplified Water Flow Diagram

Sugar Beet Processing Facility

Water In

Water Out

Sugar Beets

Freshwater

(Groundwater or Surface Water)

Evaporation

Products

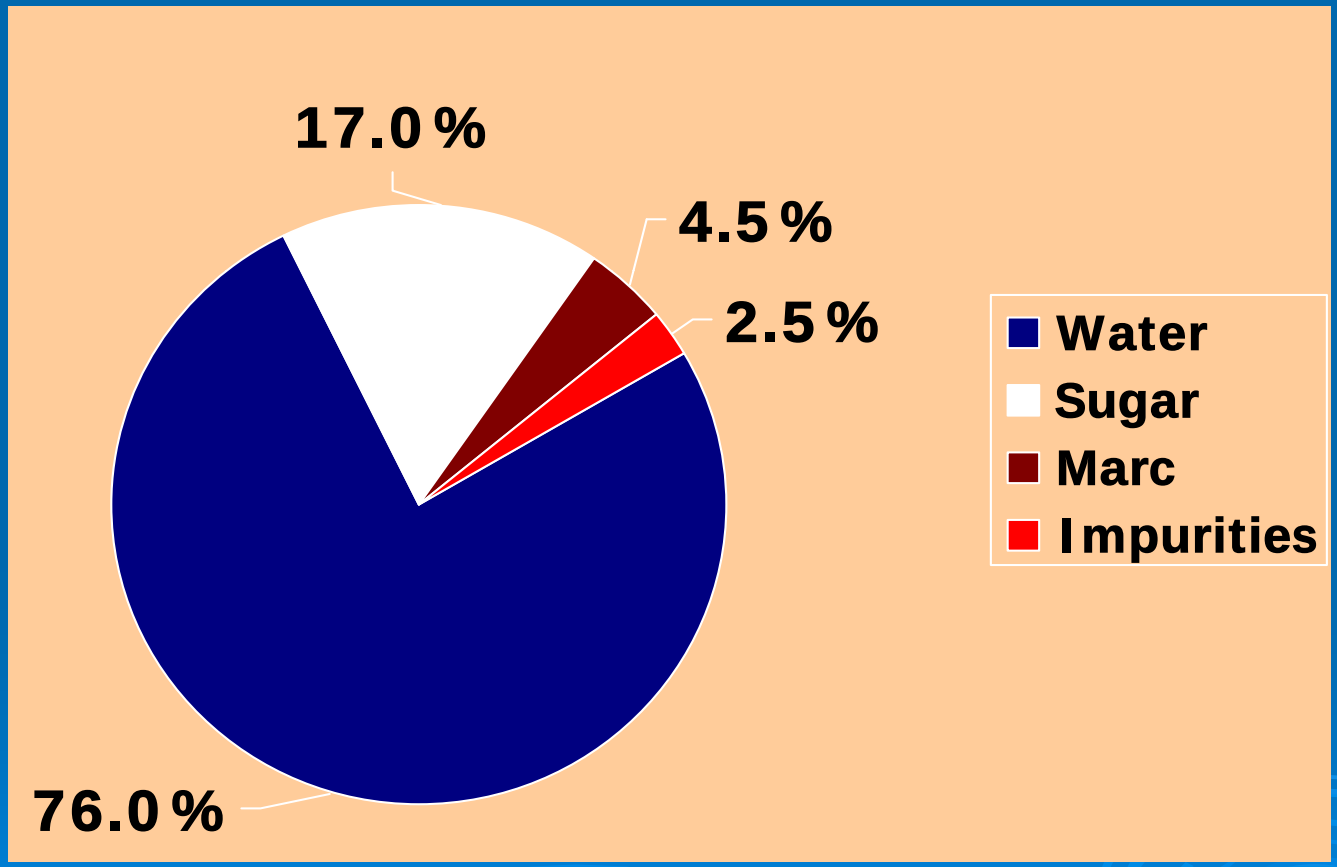
Storage Ponds & Excess Water

Recycle

Water In - Sugar Beets

- Water contained in sugar beets.
- Processing facilities are net importers of water.
- Water reuse is critical to overall balance.

Sugar Beets



Water In - Freshwater

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- Needs vary based on water system design and waste water treatment.
- Groundwater Wells
- Surface Water – Rivers, creeks and irrigation water

Water Out - Excess Condensate

- Water evaporated from sugar beets.
- High Quality (low hardness, low COD, contains a small amount of nitrogen)
- Excellent source of water for process needs and crops.

Water Out – Process Waste Water

- Excess water from recycled systems (beet flume, scrubbers and ash), floor washings, tank overflows, etc.
- Lower Quality (high hardness, high COD, contains a small amount of nitrogen)
- Aerated and either reused and/or land applied.

Water Balance
Paul, ID Facility

Water Inputs (MG's)[a]

Beet Campaign - Paul, Idaho Facility

Source	Daily	Annual
Water – Sugar Beets (97%)	3.0	540
Freshwater (3%)	0.1	18
Total	3.1	558

[a] millions of gallons

Water Outputs (MG's)[a]

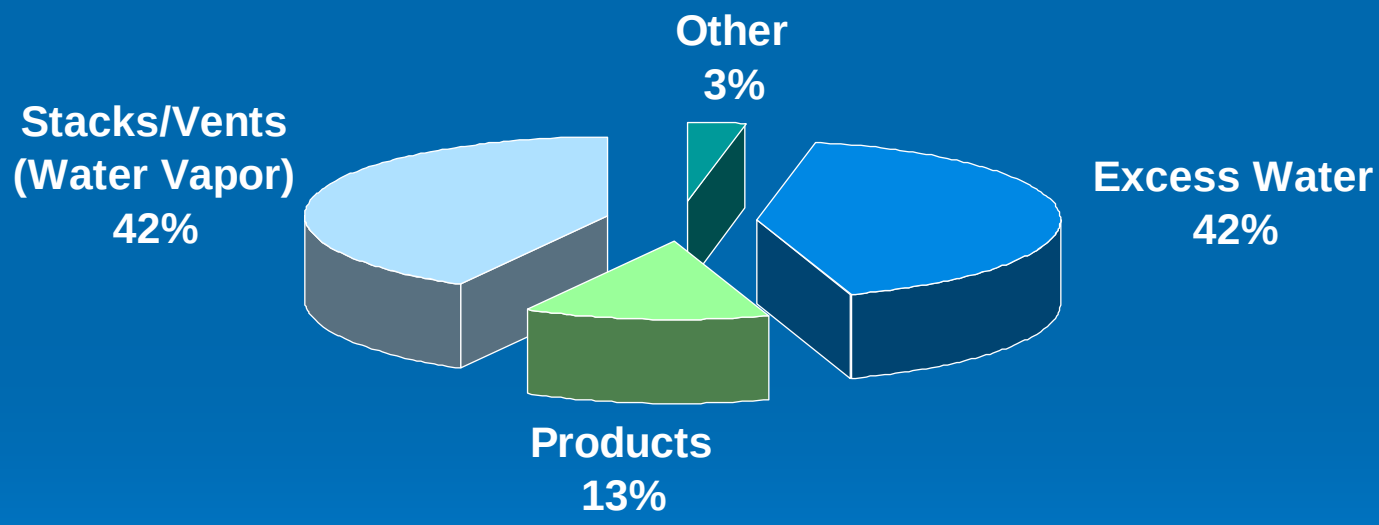
Beet Campaign - Paul, ID Facility

Source	Daily
Excess Water	**1.3**
Facility Vents (water vapor)	0.9
Cooling Towers (water vapor)	0.4
Products	0.4
Other	0.1
Total	**3.1**

[a] millions of gallons

Beet Campaign - Outputs

Water Balance



Excess Condensate

Total Quantities – Paul, ID Facility

Parameter	Amount
Daily Quantities [a]	1.1 MG/day
Campaign Days	180 days
Total Excess Condensate	199 MG's

[a] Assume 85% of total wastewater

Facility Water Reuse

Water Reuse

Sugar Beet Processing Facilities

- Facility Operations - Optimizing the use of excess condensate minimizes the need for freshwater.
- Wastewater Treatment System – Influences the amount freshwater utilized.

Water Reuse

Sugar Beet Processing Facilities

- Process Uses
- Evaporator feedwater – Juice Run
- Land apply to crops
- Pond refilling

Facility Water Systems

Sugar Beet Processing Facility

- Inside Facilities – Complex piping systems for recirculating and reusing water.
- Outside Facilities – Storage Ponds & Aeration Systems

Storage Ponds
Paul, ID Facility

- Store water for reuse during juice run and crop irrigation.
- Solids settling & aeration.

Pond Volumes

TASCO Facility Paul, ID

Ponds	Million Gallons
Excess Condensate	171
Process Water (Aerated)	42
Scrubber & Ash Ponds	3
Flumewater (Mud)	2
Sanitary Lagoon	3
Total	221

Storage Pond Water Evaporation

Paul, ID Facility

- Due to Idaho's arid climate, storage pond evaporation accounts for a significant reduction in water inventories.
- Assume 36 inches of evaporation per year.
- Evaporation per year
  - Excess Condensate = 30 MG's
  - Process Water = 17 MG's

Juice Run
Excess Condensate Reuse

Juice Run

- Stored thick juice is processed into granulated sugar following the beet campaign.
- Typically 100 days for thick juice processing.
- Evaporator feed water needed to supply vapors to sugar end equipment.

Evaporator Feed Water Sources

- Initial juice run operations in the late 1980's required the use of well water for juice runs
- Well water requires softening (TDS concentration ~ 600ppm).
- Softening water increases process waste water TDS concentrations.

Evaporator Feed Water
Excess Condensate

- Beginning in 1992, excess condensate tested as a replacement for well water.
- Since then three excess condensate storage ponds have been installed covering 40 acres with a capacity of 170 MG.

Excess Condensate

Juice Run Evaporator Feed Water

Parameter	Amount
Daily Feed Water	540,000 gpd
Juice Run Days	100
Total Feed Water	54 MG

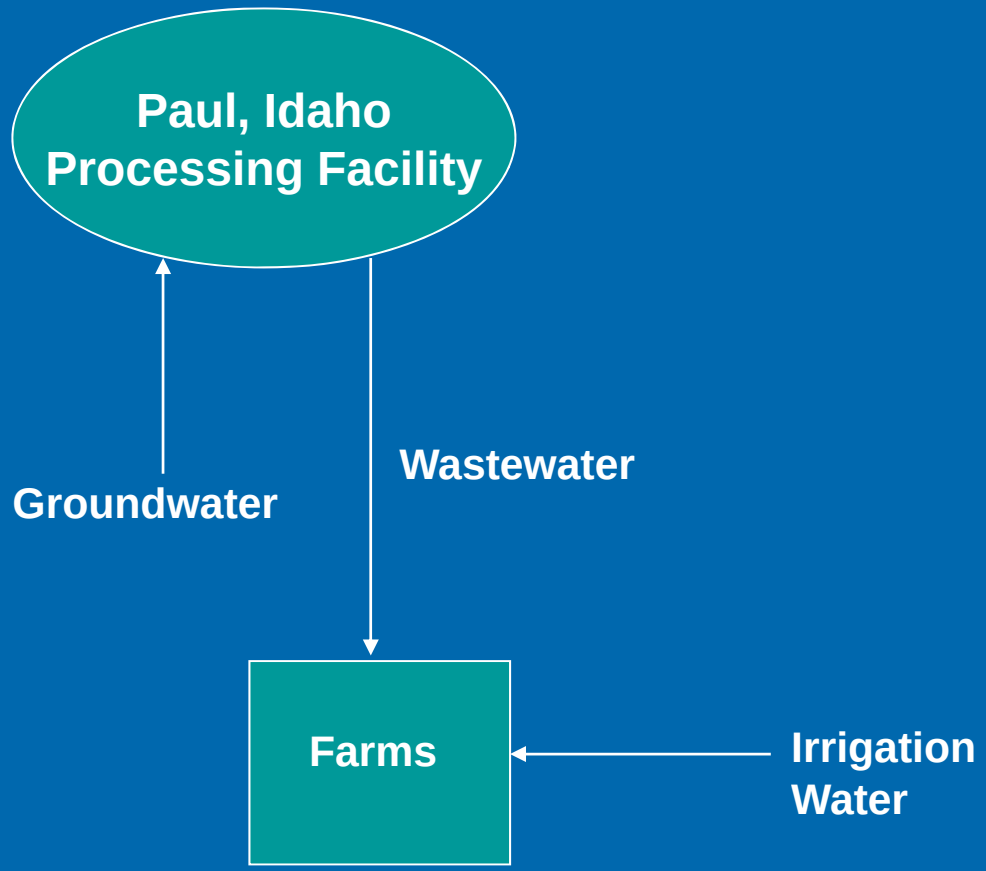
Benefits of Juice Run Excess Condensate Reuse

- Eliminates the need for 54 MG's of groundwater.
- Reduces an equivalent quantity of waste water.

Land Application of Excess Water

Wastewater Land Application System

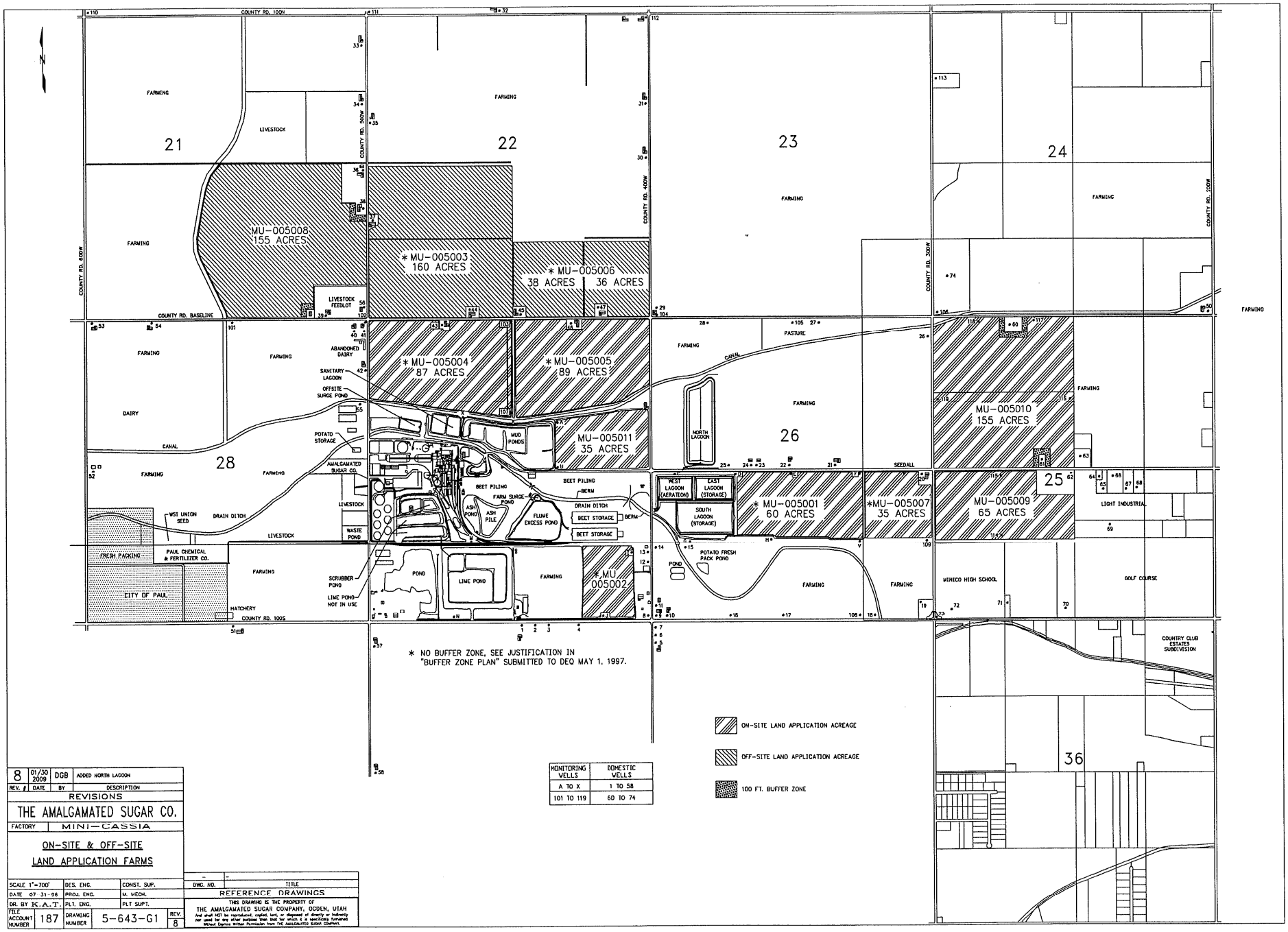
Paul, Idaho Facility



Wastewater Land Application

2007 Overview– Paul, ID Facility

- Minimizing groundwater for facility operations is critical for reducing waste water volumes.
- Excess water applied to ~700 acres of farm ground adjacent to the facility.
- Crops grown – Alfalfa, winter wheat and beans
- Excess condensate reduces the need for irrigation water (freshwater) and fertilizer.



* NO BUFFER ZONE, SEE JUSTIFICATION IN "BUFFER ZONE PLAN" SUBMITTED TO DEQ MAY 1, 1997.

MONITORING WELLS	DOMESTIC WELLS
A TO X	1 TO 58
101 TO 119	60 TO 74

ON-SITE LAND APPLICATION ACREAGE

OFF-SITE LAND APPLICATION ACREAGE

100 FT. BUFFER ZONE

REV. #	DATE	BY	DESCRIPTION
8	01/30 2009	DGB	ADDED NORTH LAGOON

REVISIONS

THE AMALGAMATED SUGAR CO.

FACTORY: MINI-CASSIA

ON-SITE & OFF-SITE LAND APPLICATION FARMS

SCALE 1"=700'	DES. ENG.	CONST. SUP.
DATE 07-31-96	PROJ. ENG.	M. MECH.
DR. BY K.A.T.	PLT. ENG.	PLT SUPT.

FILE ACCOUNT NUMBER 187 | DRAWING NUMBER 5-643-G1 | REV. 8

DWG. NO. | TITLE: REFERENCE DRAWINGS

Waste Water Land Application

Overview – Paul, ID Facility

- WW land application closely monitored by State of Idaho (IDEQ).
- Land application permit requires extensive monitoring & reporting of WW volumes & constituents, groundwater quality, soils, and crop production.

Types of Water Land Applied

Overview – Paul, ID Facility

- Process Water (15% of total) – Lower Quality
- Excess Condensate (85% of total) – Higher Quality
- Supplemental Irrigation Water needed to maintain the crops

Factory WW Quality (mg/l)

Juice Run Evaporator Feed Water

Type	COD	TKN	Ammonia	TDS
Excess Condensate	30	80	71	150
Process	270	30	4	1790

Waste Water Land Applied

2007-2008 Paul,ID Facility

Type	Amount (MG)
Excess condensate from factory	109
Process water from factory	15
Total	124

Crop Freshwater Requirements

Supplemental Irrigation Water

Factory Farms –Paul, ID Facility

- Total Water for Crop = Irrigation water + wastewater.
- Irrigation water - Largest freshwater requirement and varies based on crop type.
- For example, up to 50 in/ac/yr required for alfalfa.

Waste Water Land Applied

2007-2008 Paul,ID Facility

Type	Amount (MG)
Excess condensate from factory	109 (11%)
Process water from factory	15 (2%)
Supplemental Irrigation Water	880 (87%)

Where is most freshwater used?

- To grow the sugar beet crop.
- The estimated quantity of irrigation water for to produce 3,000,000 tons for the Paul, ID facility is 83,000 MG's.

Freshwater Balance (MG's)

3,000,000 Tons Beets – Paul, Idaho

83,000	=	Irrigation water – To grow sugar beet crop
880	=	Irrigation water – To maintain wastewater treatment farms
18	=	Well water - Facility

Facility Water Management & Conservation Goals

The Amalgamated Sugar Co. LLC

- Continue to maximize the use of water generated from processed sugar beets
- Minimize the need for surface or groundwater

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Reducing Water Footprints
Sugar Beet Growing

- Based on the overall water balance, the potential for the greatest water footprint reductions are associated with crop water requirements.