Data Processing & Structures

SEL Environmental

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Table of Contents

API Information & Breakdown

Native Variable Naming

The SEL API uses a simple, and often easily understood, variable naming scheme for the returned values in their endpoints.

One irregularity of the naming scheme relates to the identifier naming for the 'blocks' objects as the identifier names are contractions of the parent object name e.g., 'analogs' uses 'aid', 'alarms' uses 'aid', and 'outputs' uses' 'oid'.

This can cause confusion when processing the data as two of the identifiers have the same name. This will be corrected for the version aggregated into the Salford databases to avoid confusion when researchers are processing data.

Variable Reduction

The API returns three objects from a unit data request these objects being 'analogs', 'alarms', and 'outputs'.

The 'analogs' object contains the readings from the sensors that are connected to the requested unit along with related details for the reading such as the units for the reading and the start & stop conditions for a related irrigation action.

The 'alarms' object contains data relating to manually specified alarms on the SEL systems to alert a user of out-of-spec or hazardous operation or conditions in the GI. This data is not particularly useful for analysis, and so will likely be omitted from processing.

The 'outputs' object contains data relating to the actionable systems connected to that unit such as solenoid valves that control manual irrigation of the GI. The API does not allow for control of these devices, but it does show the current status of them and thus the current irrigation status of the GI can be inferred.

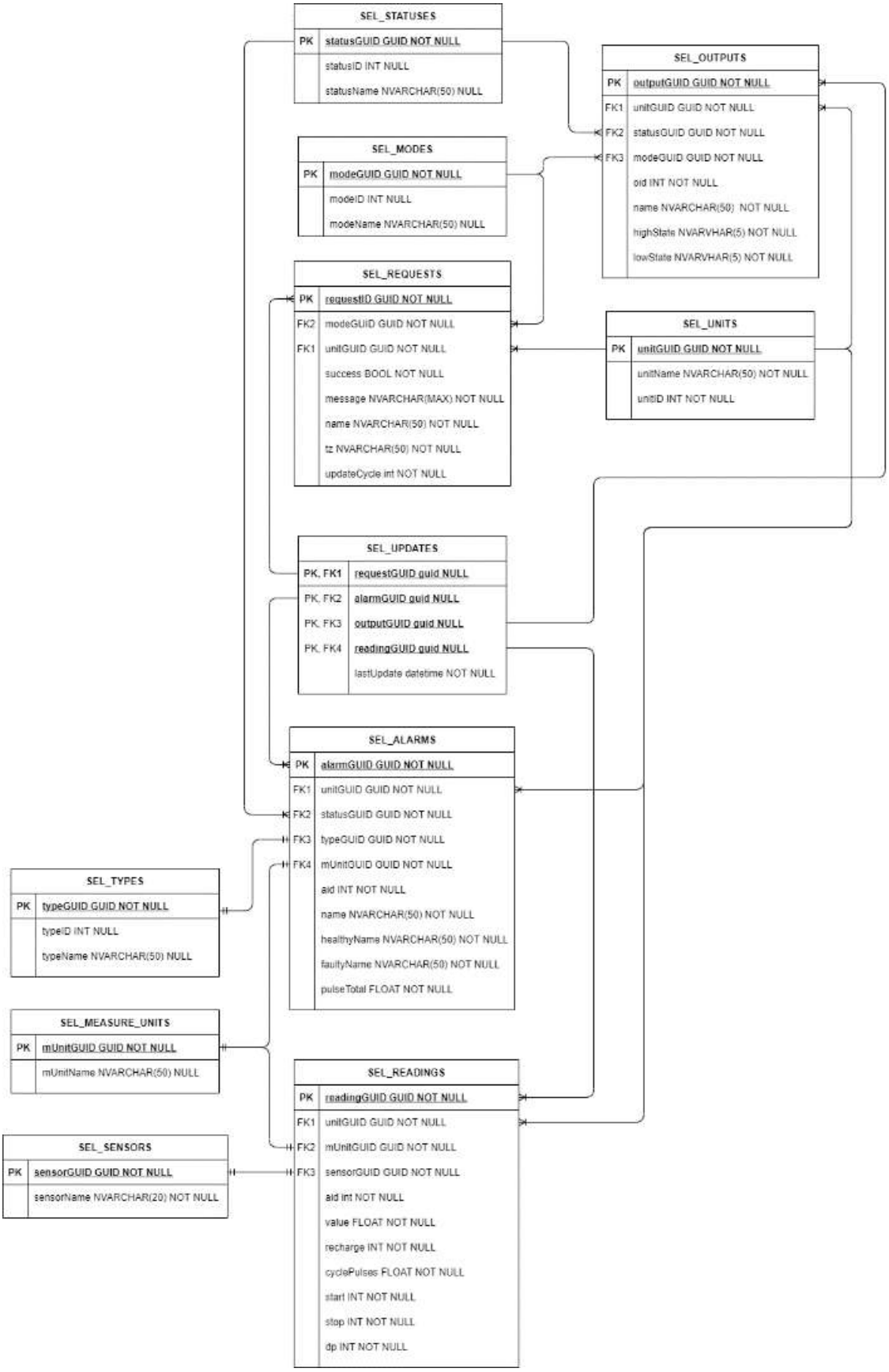
Historic Data

The RESTful API only provides endpoints for the most recent instantaneous readings from the monitoring equipment, so making the system fault tolerant to service outages won't be possible because it won't be possible to retrieve data from the period of the outage programmatically.

Normalisation

UNF Repeating attributes indented	**1-NF** Remove repeating attributes and identify PK	**2-NF** Remove partial dependencies	**3-NF** Remove non-key dependencies
success message now name id last_update success message now name last_update tz update_cycle name last_update mode aid name units value recharge cycle_pulses start stop dp aid status type name last_change healthy_name faulty_name pulse_total pulse_units oid status name mode last_update high_state low_state	**unitGUID** success message now name id last_update	**unitGUID** unitName unitID	**unitGUID** unitName unitID
			requestGUID* **readingGUID*** **alarmGUID*** **outputGUID** update_time
			modeGUID modeName modeID
	requestGUID success message now name last_update tz update_cycle	**updateGUID** lastUpdate	**typeGUID** typeID typeName
			statusGUID statusID statusName
	blockGUID name last_update mode	**requestGUID** success message now name tz update_cycle blockMode	**requestGUID** **unitGUID*** **modeGUID*** success message name tz update_cycle
	readingGUID **sensorGUID*** aid units value recharge cycle_pulses start stop dp	**readingGUID** **sensorGUID*** aid units value recharge cycle_pulses start stop dp	**readingGUID** **unitGUID*** **mUnitGUID*** **sensorGUID*** aid value recharge cycle_pulses start stop dp
	alarmGUID aid status type name last_change healthy_name faulty_name pulse_total pulse_units	**alarmGUID** aid status type name last_change healthy_name faulty_name pulse_total pulse_units	**alarmGUID** **unitGUID*** **typeGUID*** **statusGUID*** **mUnitGUID*** aid name healthy_name faulty_name pulse_total
	outputGUID oid status name mode last_update high_state low_state	**outputGUID** oid status name mode high_state low_state	**outputGUID** **unitGUID*** **modeGUID*** oid status name high_state low_state
			mUnitGUID uUnitName
	sensorGUID* sensorName	**sensorGUID*** sensorName	**sensorGUID*** sensorName

ERD


SEL_STATUSES
PK statusGUID GUID NOT NULL
statusID INT NULL
statusName NVARCHAR(50) NULL
SEL_OUTPUTS
PK outputGUID GUID NOT NULL
FK1 unitGUID GUID NOT NULL
FK2 statusGUID GUID NOT NULL
FK3 modeGUID GUID NOT NULL
oid INT NOT NULL
name NVARCHAR(50) NOT NULL
highState NVARVHAR(5) NOT NULL
lowState NVARVHAR(5) NOT NULL
SEL_MODES
PK modeGUID GUID NOT NULL
modeID INT NULL
modeName NVARCHAR(50) NULL
SEL_REQUESTS
PK requestID GUID NOT NULL
FK2 modeGUID GUID NOT NULL
FK1 unitGUID GUID NOT NULL
success BOOL NOT NULL
message NVARCHAR(MAX) NOT NULL
name NVARCHAR(50) NOT NULL
tz NVARCHAR(50) NOT NULL
updateCycle int NOT NULL
SEL_UNITS
PK unitGUID GUID NOT NULL
unitName NVARCHAR(50) NOT NULL
unitID INT NOT NULL
SEL_UPDATES
PK, FK1 requestGUID guid NULL
PK, FK2 alarmGUID guid NULL
PK, FK3 outputGUID guid NULL
PK, FK4 readingGUID guid NULL
lastUpdate datetime NOT NULL
SEL_ALARMS
PK alarmGUID GUID NOT NULL
FK1 unitGUID GUID NOT NULL
FK2 statusGUID GUID NOT NULL
FK3 typeGUID GUID NOT NULL
FK4 mUnitGUID GUID NOT NULL
aid INT NOT NULL
name NVARCHAR(50) NOT NULL
healthyName NVARCHAR(50) NOT NULL
faultyName NVARCHAR(50) NOT NULL
pulseTotal FLOAT NOT NULL
SEL_TYPES
PK typeGUID GUID NOT NULL
typeID INT NULL
typeName NVARCHAR(50) NULL
SEL_MEASURE_UNITS
PK mUnitGUID GUID NOT NULL
mUnitName NVARCHAR(50) NULL
SEL_SENSORS
PK sensorGUID GUID NOT NULL
sensorName NVARCHAR(20) NOT NULL
SEL_READINGS
PK readingGUID GUID NOT NULL
FK1 unitGUID GUID NOT NULL
FK2 mUnitGUID GUID NOT NULL
FK3 sensorGUID GUID NOT NULL
aid int NOT NULL
value FLOAT NOT NULL
recharge INT NOT NULL
cyclePulses FLOAT NOT NULL
start INT NOT NULL
stop INT NOT NULL
dp INT NOT NULL

Data Dictionaries

Units

Database:	LIVING_LAB_SEL
Entity:	SEL_UNITS
Definition:	Stores data relating to units. A unit is the transmitting device that sensors are connected to.

Attribute	Key	Data Type	Size	Input Mask/Validation	Definition
unitGUID	PK	GUID	-	N/A	Generated GUID for a unit.
unitID	-	INT	-	000-999	The ID associated with the unit by SEL.
unitName	-	NVARCHAR	50	N/A	The name of the unit assigned by SEL.

Updates

Database:	LIVING_LAB_SEL
Entity:	SEL_UPDATES
Definition:	Contains datetimes relating to the last time a particular block was updated.

Attribute	Key	Data Type	Size	Input Mask/Validation	Definition
requestGUID	PFK	GUID	-	N/A	GUID for the request section of the JSON.
alarmGUID	PFK	GUID	-	N/A	GUID for the alarm relating to this update.
readingGUID	PFK	GUID	-	N/A	GUID for the reading relating to this update.
outputGUID	PFK	GUID	-	N/A	GUID for the output relating to this update.
lastUpdate	-	DATETIME	-	YYYY-MM-DD HH:MM:SS	The datetime value itself.

Requests

Database:	LIVING_LAB_SEL
Entity:	SEL_REQUESTS
Definition:	The main body of the JSON and contains metadata about the request being made by the system against the SEL API.

Attribute	Key	Data Type	Size	Input Mask/Validation	Definition
requestGUID	PK	GUID	-	N/A	Generated GUID for the request.
unitGUID	FK	GUID	-	N/A	GUID for the unit this request was sent for.
modeGUID	FK	GUID	-	N/A	GUID for the mode reported by the API.
success	-	BOOL	-	N/A	Boolean relating to if the RESTful request was successful.
message	-	VARCHAR	35	N/A	Message reported by the API, typically tied to 'success'.
name	-	VARCHAR	50	N/A	Name transmitted in the request block, seems to be a duplicate of the unit name.
tz	-	VARCHAR	25	N/A	Time zone of the transmitting unit.
updateCycle	-	INT	-	000-999	Inferred to be the frequency that the unit transmits new data.

Readings

Database:	LIVING_LAB_SEL
Entity:	SEL_READINGS
Definition:	Stores readings from sensors in a request, known as ‘analogs’ in the JSON.

Attribute	Key	Data Type	Size	Input Mask/Validation	Definition
readingGUID	PK	GUID	-	N/A	GUID of the reading block.
unitGUID	FK	GUID	-	N/A	GUID of the unit the sensors are connected to.
mUnitGUID	FK	GUID	-	N/A	GUID of the measurement unit of the reading.
sensorGUID	FK	GUID	-	N/A	GUID of the sensor that recorded the reading.
analogID	-	INT	-	000-999	ID associated with a reading by SEL.
value	-	VARCHAR	10	N/A	Value recorded by the sensor.
recharge	-	INT	-	000-999	Unknown.
cyclePulses	-	FLOAT	-	00.00-99.99	Unknown.
readingStart	-	INT	-	000-999	Unknown.
readingStop	-	INT	-	000-999	Unknown.
dp	-	INT	-	0-9	Decimal places in the ‘value’ variable.

Alarms

Database:	LIVING_LAB_SEL
Entity:	SEL_ALARMS
Definition:	Stores alarm instances from the 'alarm' block of an API request.

Attribute	Key	Data Type	Size	Input Mask/Validation	Definition
alarmGUID	PK	GUID	-	N/A	GUID of the alarm.
unitGUID	FK	GUID	-	N/A	GUID of the unit the alarm is associated with.
typeGUID	FK	GUID	-	N/A	GUID of the type assigned to the alarm.
statusGUID	FK	GUID	-	N/A	GUID of the status assigned to the alarm.
mUnitGUID	FK	GUID	-	N/A	GUID of the measurement unit of the 'pulse'.
alarmID	-	INT	-	000—999	ID associated with an alarm by SEL.
name	-	VARCHAR	50	N/A	Name of an alarm.
healthyName	-	VARCHAR	10	N/A	Name of the alarm when in a healthy state.
faultyName	-	VARCHAR	10	N/A	Name of the alarm when in an alarming state.
pulseTotal	-	FLOAT	-	00.00- 99.99	The value of the 'pulse', reports value similar to a reading.

Outputs

Database:	LIVING_LAB_SEL
Entity:	SEL_OUTPUTS
Definition:	Stores outputs from a request. Outputs relate to irrigation solenoid statuses and their trigger points.

Attribute	Key	Data Type	Size	Input Mask/Validation	Definition
outputGUID	PK	GUID	-	N/A	GUID for the output.
unitGUID	FK	GUID	-	N/A	GUID of the unit the output device is connected to.
modeGUID	FK	GUID	-	N/A	GUID for the mode of the output.
statusGUID	FK	GUID	-	N/A	GUID for the status of the output.
outputID	-	INT	-	000-999	ID associated with the output by SEL.
outputName	-	VARCHAR	50	N/A	Name of the output.
highState	-	VARCHAR	5	N/A	The state the output device should be in when in an active state.
lowState	-	VARCHAR	5	N/A	The state the output device should be in when in an inactive state.

Modes

Database:	LIVING_LAB_SEL
Entity:	SEL_MODES
Definition:	Metadata table for modes reported by the API. Exact use unclear.

Attribute	Key	Data Type	Size	Input Mask/Validation	Definition
modeGUID	PK	GUID	-	N/A	GUID of a mode.
modeID	-	INT	-	000-999	ID of a mode assigned by SEL.
modeName	-	VARCHAR	20	N/A	Name of the mode.

Types

Database:	LIVING_LAB_SEL
Entity:	SEL_TYPES
Definition:	Metadata table for types reported by the API. Exact use unclear.

Attribute	Key	Data Type	Size	Input Mask/Validation	Definition
typeGUID	PK	GUID	-	N/A	GUID of a type.
typeID	-	INT	-	000-999	ID of a type assigned by SEL.
typeName	-	VARCHAR	20	N/A	Name of the type.

Statuses

Database:	LIVING_LAB_SEL
Entity:	SEL_STATUSES
Definition:	Metadata table for statuses reported by the API. Exact use unclear.

Attribute	Key	Data Type	Size	Input Mask/Validation	Definition
statusGUID	PK	GUID	-	N/A	GUID of a status.
statusID	-	INT	-	000-999	ID of a status assigned by SEL.
statusName	-	VARCHAR	20	N/A	Name of the status.

Measurement Units

Database:	LIVING_LAB_SEL
Entity:	SEL_MEASURE_UNITS
Definition:	Stores data about the measurement units reported by readings and alarms.

Attribute	Key	Data Type	Size	Input Mask/Validation	Definition
mUnitGUID	PK	GUID	-	N/A	GUID of a unit.
mUnitName	-	VARCHAR	20	N/A	Name of a unit.

Sensors

Database:	LIVING_LAB_SEL
Entity:	SEL_SENSORS
Definition:	Stores data about sensors connected to a unit.

Attribute	Key	Data Type	Size	Input Mask/Validation	Definition
sensorGUID	PK	GUID	-	N/A	GUID of a sensor.
sensorName	-	VARCHAR	20	N/A	Name of the sensor.