

# CPSC 304 Project Cover Page

Milestone #:   2  

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Group Number:   68  

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By typing our names and student numbers in the above table, we certify that the work in the attached assignment was performed solely by those whose names and student IDs are included above. (In the case of Project Milestone 0, the main purpose of this page is for you to let us know your e-mail address, and then let us assign you to a TA for your project supervisor.)

In addition, we indicate that we are fully aware of the rules and consequences of plagiarism, as set forth by the Department of Computer Science and the University of British Columbia

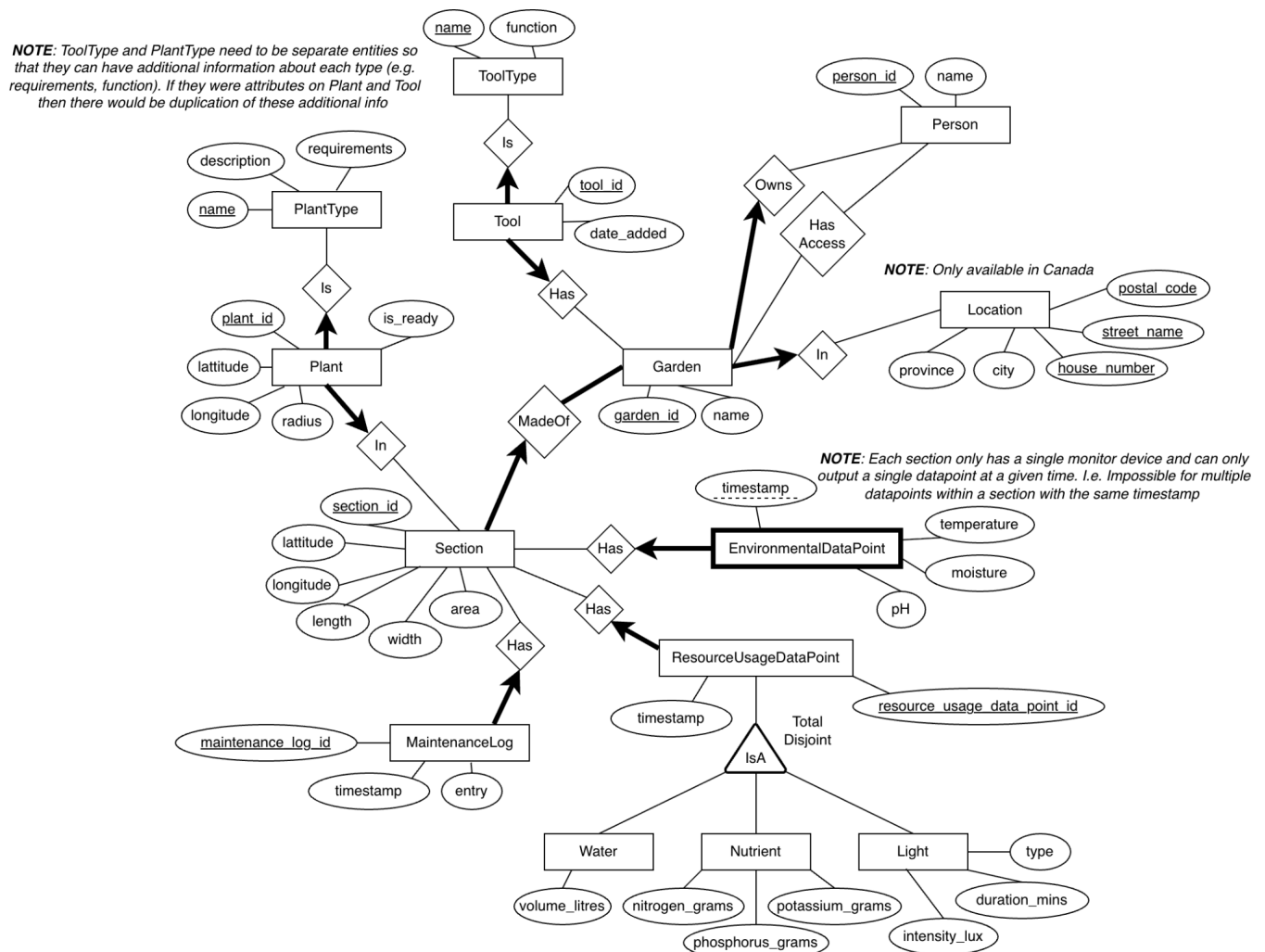
## **PROJECT SUMMARY**

Our project is a smart-garden monitoring system that allows for a garden to be broken up into sections, each of which may be allocated resources, plants, and tools as required. Each section has a monitoring system which tracks various environmental endpoints and resource usage, as well as maintains a maintenance log. Every garden has an owner and others may be granted access to it.

## ER DIAGRAM

### Changes

- The ID's associated with each entity were renamed to be more specific and desc associated with PlantType was renamed to description because desc has a sql functionality.
- Entities ResourceUsageDataPoint and MaintenanceLog are no longer weak entities and they contain separate primary keys (IDs), according to TA suggestions.
- See ER diagram for additional explanations on TA suggestions that were not incorporated.



## RELATIONAL SCHEMAS

- Primary Key: underlined
- Foreign Key: **bolded**

Person(person\_id : INT, name : VARCHAR(200))

- name: NOT NULL

Location(postal\_code : VARCHAR(200), province : VARCHAR(200), city : VARCHAR(200),  
street\_name : VARCHAR(200), house\_number : INT)

- province: NOT NULL
- city: NOT NULL
- CK: province, city, street\_name, house\_number

Tool(tool\_id : INT, date\_added : DATE, **garden\_id** : INT, **type\_name**: VARCHAR(200))

- garden\_id: NOT NULL
- type\_name: NOT NULL
- date\_added: NOT NULL

ToolType(name : VARCHAR(200), function : VARCHAR(200))

- function: NOT NULL, UNIQUE
- CK: function

MaintenanceLog(maintenance\_log\_id : INT, timestamp : TIMESTAMP, entry : VARCHAR(200),  
**section\_id** : INT)

- section\_id: NOT NULL
- timestamp: NOT NULL
- entry: NOT NULL

Garden(garden\_id : INT, name : VARCHAR(200), **postal\_code** : CHAR(6), **street\_name** :  
VARCHAR(200), **house\_number** : INT, **owner\_id** : INT)

- owner\_id: NOT NULL
- postal\_code: NOT NULL
- street\_name: NOT NULL
- house\_number: NOT NULL
- name: NOT NULL

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HasAccess(garden\_id : INT, person\_id : INT)

Section(section\_id : INT, latitude : NUMBER, longitude : NUMBER, length : NUMBER, width :  
NUMBER, area: NUMBER, **garden\_id** : INT)

- garden\_id: NOT NULL
- length: NOT NULL
- width NOT NULL
- area: NOT NULL

Plant(plant\_id : INT, latitude : NUMBER, longitude : NUMBER, radius : NUMBER, is\_ready :  
INT, **type\_name** : VARCHAR(200), **section\_id** : INT)

- type\_name: NOT NULL
- section\_id: NOT NULL
- latitude: NOT NULL
- longitude: NOT NULL
- radius: NOT NULL
- is\_ready: NOT NULL

PlantType(requirements : VARCHAR(200), description : VARCHAR(200), name :  
VARCHAR(200))

- description: NOT NULL, UNIQUE
- CK : description

EnvironmentalDataPoint(timestamp : TIMESTAMP, **section\_id** : INT, temperature : NUMBER,  
moisture : NUMBER, pH : NUMBER)

Water(resource\_usage\_data\_point\_id : INT, timestamp : TIMESTAMP, volume\_litres :  
NUMBER, **section\_id** : INT)

- timestamp: NOT NULL
- section\_id: NOT NULL
- volume\_litres: NOT NULL

Nutrient(resource\_usage\_data\_point\_id : INT, timestamp : TIMESTAMP, nitrogen\_grams :  
NUMBER, potassium\_grams : NUMBER, phosphorus\_grams : NUMBER, **section\_id** : INT)

- timestamp: NOT NULL

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section\_id: NOT NULL

Light(resource\_usage\_data\_point\_id : INT, timestamp : TIMESTAMP, intensity\_lux : NUMBER,  
duration\_mins : NUMBER, type : VARCHAR(200), **section\_id** : INT)

- timestamp: NOT NULL
- section\_id: NOT NULL
- intensity\_lux: NOT NULL
- duration\_mins: NOT NULL
- type: NOT NULL

## **FUNCTIONAL DEPENDENCIES**

Person:

- $\text{person\_id} \rightarrow \text{name}$

Section:

- $\text{length, width} \rightarrow \text{area}$
- $\text{section\_id} \rightarrow \text{latitude, longitude, length, width, area, garden\_id}$

Location:

- $\text{province, city} \rightarrow \text{postal\_code}$
- $\text{postal\_code} \rightarrow \text{province, city}$

Garden:

- $\text{garden\_id} \rightarrow \text{name, location\_id, owner\_id}$

Tool:

- $\text{tool\_id} \rightarrow \text{date\_added, garden\_id, type\_name}$

ToolType

- $\text{name} \rightarrow \text{function}$

Plant:

- $\text{plant\_id} \rightarrow \text{latitude, longitude, radius, is\_ready, type\_name, section\_id}$

PlantType:

- $\text{name} \rightarrow \text{description, requirements}$

MaintenanceLog:

- $\text{maintenance\_log\_id} \rightarrow \text{timestamp, entry}$

ResourceUsageDataPoint:

- $\text{resource\_usage\_data\_point\_id} \rightarrow \text{timestamp, volume\_litres}$
- $\text{resource\_usage\_data\_point\_id} \rightarrow \text{timestamp, nitrogen\_grams, phosphorus\_grams, potassium\_grams}$
- $\text{resource\_usage\_data\_point\_id} \rightarrow \text{timestamp, type, duration\_mins, intensity\_lux}$

EnvironmentalDataPoint:

- $\text{timestamp, section\_id} \rightarrow \text{temperature, moisture, pH}$

## **NORMALIZATION - BCNF**

**For Section:** length = L, width = W, area = A, section\_id = S, latitude = Lat, longitude = Long, garden\_id = G

FD:  $LW \rightarrow A$ , LW is not a superkey so BCNF is violated. So decompose on  $LW \rightarrow A$

S G Lat Long LW A

- So SectionDimensions includes LW and what is to the right of it
- So Sections includes LW and what is to the left of it

SectionDimensions(L, W, A) and Section(S, G, Lat, Long, L, W)

With SectionDimensions and Sections we are now in BCNF because the FDs hold:

- SectionDimensions is in BCNF (The key LW is a superkey)
- Sections is in BCNF (The key S is a superkey)

So after normalization, the primary keys are L and W for R1, and S for R2. The foreign keys are G, L and W. The candidate key for R1 is the same as the primary key (LW) and the candidate key for R2 is the same as the primary key (S). Final tables are:

- SectionDimensions( length : NUMBER, width : NUMBER, area : NUMBER)
- Sections( section\_id : INT, **garden\_id** : INT, **latitude** : NUMBER, **longitude** : NUMBER , length : NUMBER, width : NUMBER)

**Location:** province = P, city = C, postal\_code = O, street\_name = S, house\_number = H

FD:  $O \rightarrow PC$ , O is not a superkey so BCNF is violated

Decompose on  $O \rightarrow PC$

Location(O, H, S) PostalCode(O, P, C)

Now all FDs hold. The primary keys are O, H, S for Location and O for PostalCode. P, C is also a candidate key for PostalCode. The SQL DDL statements required to create all the tables from item #6.



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UPDATED FUNCTIONAL DEPENDENCIES:

Person:

- $\text{person\_id} \rightarrow \text{name}$

SectionDimensions:

- $\text{length, width} \rightarrow \text{area}$

Sections:

- $\text{section\_id} \rightarrow \text{latitude, longitude, length, width, area, garden\_id}$

Location:

- $\text{postal\_code, house\_number, street\_name}$

PostalCode:

- $\text{postal\_code} \rightarrow \text{province, city}$

Garden:

- $\text{garden\_id} \rightarrow \text{name, location\_id, owner\_id}$

Tool:

- $\text{tool\_id} \rightarrow \text{date\_added, garden\_id, type\_name}$

ToolType

- $\text{name} \rightarrow \text{function}$

Plant:

- $\text{plant\_id} \rightarrow \text{latitude, longitude, radius, is\_ready, type\_name, section\_id}$

PlantType:

- $\text{name} \rightarrow \text{description, requirements}$

MaintenanceLog:

- $\text{maintenance\_log\_id} \rightarrow \text{timestamp, entry}$

ResourceUsageDataPoint:

- $\text{resource\_usage\_data\_point\_id} \rightarrow \text{timestamp, volume\_litres}$
- $\text{resource\_usage\_data\_point\_id} \rightarrow \text{timestamp, nitrogen\_grams, phosphorus\_grams, potassium\_grams}$
- $\text{resource\_usage\_data\_point\_id} \rightarrow \text{timestamp, type, duration\_mins, intensity\_lux}$

EnvironmentalDataPoint:

- $\text{timestamp, section\_id} \rightarrow \text{temperature, moisture, pH}$

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**TABLE DDL STATEMENTS (all create and insert statements also included in .sql file)**

```
CREATE TABLE Person (  
    person_id INT PRIMARY KEY,  
    name VARCHAR(200) NOT NULL  
);  
  
CREATE TABLE PostalCode (  
    postal_code CHAR(6) PRIMARY KEY,  
    province VARCHAR(200) NOT NULL,  
    city VARCHAR(200) NOT NULL  
);  
  
CREATE TABLE ToolType (  
    name VARCHAR(200) PRIMARY KEY,  
    function VARCHAR(200) UNIQUE NOT NULL  
);  
  
CREATE TABLE PlantType (  
    name VARCHAR(200) PRIMARY KEY,  
    requirements VARCHAR(200),  
    description VARCHAR(200) UNIQUE NOT NULL  
);  
  
CREATE TABLE SectionDimensions (  
    length NUMBER,  
    width NUMBER,  
    area NUMBER NOT NULL,  
    PRIMARY KEY (length, width)  
);  
  
CREATE TABLE Location (  
    postal_code CHAR(6),  
    house_number INT,  
    street_name VARCHAR(200),  
    PRIMARY KEY (postal_code, house_number, street_name),  
    FOREIGN KEY (postal_code) REFERENCES PostalCode  
);  
  
CREATE TABLE Garden (  
    garden_id INT PRIMARY KEY,  
    name VARCHAR(200) NOT NULL,  
    postal_code CHAR(6) NOT NULL,  
    street_name VARCHAR(200) NOT NULL,
```

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```
        house_number INT NOT NULL,  
        owner_id INT NOT NULL,  
        FOREIGN KEY (postal_code, house_number, street_name) REFERENCES Location,  
        FOREIGN KEY (owner_id) REFERENCES Person(person_id)  
    );
```

```
CREATE TABLE Tool (  
    tool_id INT PRIMARY KEY,  
    date_added DATE NOT NULL,  
    garden_id INT NOT NULL,  
    type_name VARCHAR(200) NOT NULL,  
    FOREIGN KEY (garden_id) REFERENCES Garden,  
    FOREIGN KEY (type_name) REFERENCES ToolType(name)  
);
```

```
CREATE TABLE HasAccess (  
    garden_id INT,  
    person_id INT,  
    PRIMARY KEY (garden_id, person_id),  
    FOREIGN KEY (garden_id) REFERENCES Garden,  
    FOREIGN KEY (person_id) REFERENCES Person  
);
```

```
CREATE TABLE Section (  
    section_id INT PRIMARY KEY,  
    garden_id INT NOT NULL,  
    latitude NUMBER NOT NULL,  
    longitude NUMBER NOT NULL,  
    length NUMBER NOT NULL,  
    width NUMBER NOT NULL,  
    FOREIGN KEY (garden_id) REFERENCES Garden,  
    FOREIGN KEY (length, width) REFERENCES SectionDimensions  
);
```

```
CREATE TABLE Plant (  
    plant_id INT PRIMARY KEY,  
    latitude NUMBER NOT NULL,  
    longitude NUMBER NOT NULL,  
    radius NUMBER NOT NULL,  
    is_ready INT NOT NULL,  
    type_name VARCHAR(200) NOT NULL,  
    section_id INT NOT NULL,  
    FOREIGN KEY (type_name) REFERENCES PlantType(name),  
    FOREIGN KEY (section_id) REFERENCES Section  
);
```

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```
CREATE TABLE EnvironmentalDataPoint (  
    timestamp TIMESTAMP,  
    section_id INT,  
    temperature NUMBER,  
    moisture NUMBER,  
    pH NUMBER,  
    PRIMARY KEY (timestamp, section_id),  
    FOREIGN KEY (section_id) REFERENCES Section  
);  
-- foreign key section_id should have ON DELETE CASCADE ON UPDATE CASCADE even though  
oracle doesn't support this  
- this is a weak entity so it depends upon the owner entity for identification, in  
the case that a tuple from the owner is deleted, the associated row in the weak  
entity table no longer has any meaning/context and should also be removed.
```

```
CREATE TABLE MaintenanceLog (  
    maintenance_log_id INT PRIMARY KEY,  
    timestamp TIMESTAMP NOT NULL,  
    entry VARCHAR(200) NOT NULL,  
    section_id INT NOT NULL,  
    FOREIGN KEY (section_id) REFERENCES Section  
);
```

```
CREATE TABLE Water (  
    resource_usage_data_point_id INT PRIMARY KEY,  
    timestamp TIMESTAMP NOT NULL,  
    volume_litres NUMBER NOT NULL,  
    section_id INT NOT NULL,  
    FOREIGN KEY (section_id) REFERENCES Section  
);
```

```
CREATE TABLE Nutrient (  
    resource_usage_data_point_id INT PRIMARY KEY,  
    timestamp TIMESTAMP NOT NULL,  
    nitrogen_grams NUMBER,  
    potassium_grams NUMBER,  
    phosphorus_grams NUMBER,  
    section_id INT NOT NULL,  
    FOREIGN KEY (section_id) REFERENCES Section  
);
```

```
CREATE TABLE Light (  
    resource_usage_data_point_id INT PRIMARY KEY,  
    timestamp TIMESTAMP NOT NULL,  
    intensity_lux NUMBER NOT NULL,  
    duration_mins NUMBER NOT NULL,
```

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```
type VARCHAR(200) NOT NULL,  
section_id INT NOT NULL,  
FOREIGN KEY (section_id) REFERENCES Section  
);
```

### TABLE INSERT STATEMENTS

```
-- 1. Person  
INSERT INTO Person (person_id, name) VALUES (1, 'Sarah Johnson');  
INSERT INTO Person (person_id, name) VALUES (2, 'Michael Chen');  
INSERT INTO Person (person_id, name) VALUES (3, 'Emily Rodriguez');  
INSERT INTO Person (person_id, name) VALUES (4, 'David Thompson');  
INSERT INTO Person (person_id, name) VALUES (5, 'Jessica Williams');  
INSERT INTO Person (person_id, name) VALUES (6, 'Robert Martinez');  
INSERT INTO Person (person_id, name) VALUES (7, 'Amanda Lee');  
  
-- 2. PostalCode  
INSERT INTO PostalCode (postal_code, province, city)  
VALUES ('V6T1Z4', 'British Columbia', 'Vancouver');  
INSERT INTO PostalCode (postal_code, province, city)  
VALUES ('V5K0A1', 'British Columbia', 'Vancouver');  
INSERT INTO PostalCode (postal_code, province, city)  
VALUES ('V7M2E3', 'British Columbia', 'North Vancouver');  
INSERT INTO PostalCode (postal_code, province, city)  
VALUES ('V3H4K6', 'British Columbia', 'Burnaby');  
INSERT INTO PostalCode (postal_code, province, city)  
VALUES ('V6B1A1', 'British Columbia', 'Vancouver');  
INSERT INTO PostalCode (postal_code, province, city)  
VALUES ('V4N3M2', 'British Columbia', 'Richmond');  
  
-- 3. ToolType  
INSERT INTO ToolType (name, function)  
VALUES ('Shovel', 'Digging into soil');  
INSERT INTO ToolType (name, function)  
VALUES ('Rake', 'Gathering leaves or leveling soil');  
INSERT INTO ToolType (name, function)  
VALUES ('Pruning Shears', 'Trimming and shaping plants');  
INSERT INTO ToolType (name, function)  
VALUES ('Watering Can', 'Manual watering of plants');  
INSERT INTO ToolType (name, function)  
VALUES ('Hoe', 'Breaking up soil');  
INSERT INTO ToolType (name, function)  
VALUES ('Trowel', 'Small-scale digging and planting');  
INSERT INTO ToolType (name, function)  
VALUES ('Garden Fork', 'Turning and aerating compost');
```

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### -- 4. PlantType

```
INSERT INTO PlantType (name, requirements, description) VALUES ('Tomato', 'Full sun,
regular watering, pH 6.0-6.8', 'make into sauces for pasta');
INSERT INTO PlantType (name, requirements, description) VALUES ('Lettuce', 'Partial
shade, consistent moisture, pH 6.0-7.0', 'used for salads');
INSERT INTO PlantType (name, requirements, description) VALUES ('Carrot', 'Full sun,
loose soil, pH 6.0-6.8', 'root vegetable good for soups');
INSERT INTO PlantType (name, requirements, description) VALUES ('Basil', 'Full sun,
warm temperatures, pH 6.0-7.0', 'herb plant');
INSERT INTO PlantType (name, requirements, description) VALUES ('Cucumber', 'Full
sun, consistent watering, pH 6.0-7.0', 'great veggie to dip in hummus');
INSERT INTO PlantType (name, requirements, description) VALUES ('Bell Pepper', 'Full
sun, warm soil, pH 6.0-6.8', 'not very spicy pepper, comes in red, green, orange, and
yellow');
INSERT INTO PlantType (name, requirements, description) VALUES ('Strawberry', 'Full
sun, well-drained soil, pH 5.5-6.5', 'yummy berry good in cakes');
```

### -- 5. SectionDimensions

```
INSERT INTO SectionDimensions(length, width, area) VALUES (10.5, 9.3, 97.65);
INSERT INTO SectionDimensions(length, width, area) VALUES (5.5, 12.92, 71.06);
INSERT INTO SectionDimensions(length, width, area) VALUES (7.3, 8.12, 59.276);
INSERT INTO SectionDimensions(length, width, area) VALUES (10.9, 11.4, 124.26);
INSERT INTO SectionDimensions(length, width, area) VALUES (12.5, 11.7, 146.25);
```

### -- 6. Location

```
INSERT INTO Location (postal_code, house_number, street_name) VALUES ('V6T1Z4', 2329,
'West Mall');
INSERT INTO Location (postal_code, house_number, street_name) VALUES ('V5K0A1', 1234,
'Commercial Drive');
INSERT INTO Location (postal_code, house_number, street_name) VALUES ('V7M2E3', 567,
'Lonsdale Avenue');
INSERT INTO Location (postal_code, house_number, street_name) VALUES ('V3H4K6', 8900,
'Eastlake Drive');
INSERT INTO Location (postal_code, house_number, street_name) VALUES ('V6B1A1', 456,
'Granville Street');
INSERT INTO Location (postal_code, house_number, street_name) VALUES ('V4N3M2', 7890,
'Garden City Road');
```

### -- 7. Garden

```
INSERT INTO Garden (garden_id, name, postal_code, street_name, house_number,
owner_id)
VALUES (1, 'UBC Community Garden', 'V6T1Z4', 'West Mall', 2329, 1);

INSERT INTO Garden (garden_id, name, postal_code, street_name, house_number,
owner_id)
```

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```
VALUES (2, 'Sunrise Urban Farm', 'V5K0A1', 'Commercial Drive', 1234, 2);

INSERT INTO Garden (garden_id, name, postal_code, street_name, house_number,
owner_id)
VALUES (3, 'North Shore Garden Haven', 'V7M2E3', 'Lonsdale Avenue', 567, 3);

INSERT INTO Garden (garden_id, name, postal_code, street_name, house_number,
owner_id)
VALUES (4, 'Burnaby Heights Garden', 'V3H4K6', 'Eastlake Drive', 8900, 4);

INSERT INTO Garden (garden_id, name, postal_code, street_name, house_number,
owner_id)
VALUES (5, 'Downtown Rooftop Garden', 'V6B1A1', 'Granville Street', 456, 5);

INSERT INTO Garden (garden_id, name, postal_code, street_name, house_number,
owner_id)
VALUES (6, 'Richmond Family Garden', 'V4N3M2', 'Garden City Road', 7890, 6);

-- 8. Tool
INSERT INTO Tool (tool_id, date_added, garden_id, type_name)
VALUES (1, DATE '2024-03-15', 1, 'Shovel');

INSERT INTO Tool (tool_id, date_added, garden_id, type_name)
VALUES (2, DATE '2024-03-15', 1, 'Rake');

INSERT INTO Tool (tool_id, date_added, garden_id, type_name)
VALUES (3, DATE '2024-04-01', 1, 'Watering Can');

INSERT INTO Tool (tool_id, date_added, garden_id, type_name)
VALUES (4, DATE '2024-02-10', 2, 'Pruning Shears');

INSERT INTO Tool (tool_id, date_added, garden_id, type_name)
VALUES (5, DATE '2024-03-20', 2, 'Hoe');

INSERT INTO Tool (tool_id, date_added, garden_id, type_name)
VALUES (6, DATE '2024-01-05', 3, 'Trowel');

INSERT INTO Tool (tool_id, date_added, garden_id, type_name)
VALUES (7, DATE '2024-03-10', 3, 'Garden Fork');

INSERT INTO Tool (tool_id, date_added, garden_id, type_name)
VALUES (8, DATE '2024-04-15', 4, 'Shovel');

INSERT INTO Tool (tool_id, date_added, garden_id, type_name)
VALUES (9, DATE '2024-05-01', 5, 'Watering Can');
```

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### -- 9. HasAccess

```
INSERT INTO HasAccess (garden_id, person_id) VALUES (1, 1);
INSERT INTO HasAccess (garden_id, person_id) VALUES (1, 2);
INSERT INTO HasAccess (garden_id, person_id) VALUES (1, 7);
INSERT INTO HasAccess (garden_id, person_id) VALUES (2, 2);
INSERT INTO HasAccess (garden_id, person_id) VALUES (2, 3);
INSERT INTO HasAccess (garden_id, person_id) VALUES (3, 3);
INSERT INTO HasAccess (garden_id, person_id) VALUES (3, 4);
INSERT INTO HasAccess (garden_id, person_id) VALUES (4, 4);
INSERT INTO HasAccess (garden_id, person_id) VALUES (5, 5);
INSERT INTO HasAccess (garden_id, person_id) VALUES (6, 6);
```

### -- 10. Section

```
INSERT INTO Section (section_id, garden_id, latitude, longitude, length, width)
VALUES (1, 1, 49.2606, -123.2460, 10.5, 9.3);
```

```
INSERT INTO Section (section_id, garden_id, latitude, longitude, length, width)
VALUES (2, 1, 49.2608, -123.2462, 5.5, 12.92);
```

```
INSERT INTO Section (section_id, garden_id, latitude, longitude, length, width)
VALUES (3, 2, 49.2698, -123.0693, 7.3, 8.12);
```

```
INSERT INTO Section (section_id, garden_id, latitude, longitude, length, width)
VALUES (4, 2, 49.2700, -123.0695, 10.9, 11.4);
```

```
INSERT INTO Section (section_id, garden_id, latitude, longitude, length, width)
VALUES (5, 3, 49.3163, -123.0755, 12.5, 11.7);
```

```
INSERT INTO Section (section_id, garden_id, latitude, longitude, length, width)
VALUES (6, 4, 49.2488, -122.9805, 5.5, 12.92);
```

```
INSERT INTO Section (section_id, garden_id, latitude, longitude, length, width)
VALUES (7, 5, 49.2827, -123.1207, 7.3, 8.12);
```

### -- 11. Plant

```
INSERT INTO Plant (plant_id, latitude, longitude, radius, is_ready, type_name,
section_id)
VALUES (1, 49.2606, -123.2460, 0.3, 1, 'Tomato', 1);
```

```
INSERT INTO Plant (plant_id, latitude, longitude, radius, is_ready, type_name,
section_id)
VALUES (2, 49.2606, -123.2461, 0.25, 1, 'Tomato', 1);
```

```
INSERT INTO Plant (plant_id, latitude, longitude, radius, is_ready, type_name,
section_id)
VALUES (3, 49.2607, -123.2460, 0.2, 0, 'Basil', 1);
```



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```
INSERT INTO Plant (plant_id, latitude, longitude, radius, is_ready, type_name,
section_id)
VALUES (4, 49.2608, -123.2462, 0.15, 1, 'Lettuce', 2);
```

```
INSERT INTO Plant (plant_id, latitude, longitude, radius, is_ready, type_name,
section_id)
VALUES (5, 49.2608, -123.2463, 0.15, 1, 'Lettuce', 2);
```

```
INSERT INTO Plant (plant_id, latitude, longitude, radius, is_ready, type_name,
section_id)
VALUES (6, 49.2698, -123.0693, 0.25, 0, 'Carrot', 3);
```

```
INSERT INTO Plant (plant_id, latitude, longitude, radius, is_ready, type_name,
section_id)
VALUES (7, 49.2699, -123.0694, 0.3, 1, 'Cucumber', 3);
```

```
INSERT INTO Plant (plant_id, latitude, longitude, radius, is_ready, type_name,
section_id)
VALUES (8, 49.2700, -123.0695, 0.25, 0, 'Bell Pepper', 4);
```

```
INSERT INTO Plant (plant_id, latitude, longitude, radius, is_ready, type_name,
section_id)
VALUES (9, 49.3163, -123.0755, 0.2, 1, 'Strawberry', 5);
```

```
INSERT INTO Plant (plant_id, latitude, longitude, radius, is_ready, type_name,
section_id)
VALUES (10, 49.2488, -122.9805, 0.3, 1, 'Tomato', 6);
```

-- 12. EnvironmentalDataPoint

```
INSERT INTO EnvironmentalDataPoint (timestamp, section_id, temperature, moisture, pH)
VALUES (TIMESTAMP '2024-10-01 08:00:00', 1, 22.5, 65.0, 6.5);
```

```
INSERT INTO EnvironmentalDataPoint (timestamp, section_id, temperature, moisture, pH)
VALUES (TIMESTAMP '2024-10-01 14:00:00', 1, 25.8, 58.0, 6.4);
```

```
INSERT INTO EnvironmentalDataPoint (timestamp, section_id, temperature, moisture, pH)
VALUES (TIMESTAMP '2024-10-02 08:00:00', 1, 21.3, 70.0, 6.6);
```

```
INSERT INTO EnvironmentalDataPoint (timestamp, section_id, temperature, moisture, pH)
VALUES (TIMESTAMP '2024-10-01 08:00:00', 2, 23.1, 62.0, 6.8);
```

```
INSERT INTO EnvironmentalDataPoint (timestamp, section_id, temperature, moisture, pH)
VALUES (TIMESTAMP '2024-10-01 08:00:00', 3, 24.0, 55.0, 6.2);
```

```
INSERT INTO EnvironmentalDataPoint (timestamp, section_id, temperature, moisture, pH)
```

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```
VALUES (TIMESTAMP '2024-10-01 08:00:00', 4, 22.8, 60.0, 6.7);
```

```
INSERT INTO EnvironmentalDataPoint (timestamp, section_id, temperature, moisture, pH)
VALUES (TIMESTAMP '2024-10-01 08:00:00', 5, 20.5, 68.0, 5.8);
```

```
-- 13. MaintenanceLog
```

```
INSERT INTO MaintenanceLog (maintenance_log_id, timestamp, entry, section_id)
VALUES (1, TIMESTAMP '2024-09-15 10:30:00', 'weeded entire section and added
nutrients to tomato plants', 1);
```

```
INSERT INTO MaintenanceLog (maintenance_log_id, timestamp, entry, section_id)
VALUES (2, TIMESTAMP '2024-09-20 14:15:00', 'pruned tomato plants and removed
diseased leaves', 1);
```

```
INSERT INTO MaintenanceLog (maintenance_log_id, timestamp, entry, section_id)
VALUES (3, TIMESTAMP '2024-09-22 14:15:00', 'harvested lettuce heads, replanted new
seedlings', 2);
```

```
INSERT INTO MaintenanceLog (maintenance_log_id, timestamp, entry, section_id)
VALUES (4, TIMESTAMP '2024-09-25 11:45:00', 'applied organic fertilizer to cucumber
vines', 3);
```

```
INSERT INTO MaintenanceLog (maintenance_log_id, timestamp, entry, section_id)
VALUES (5, TIMESTAMP '2024-09-28 16:20:00', 'installed trellis system for cucumber
plants', 3);
```

```
INSERT INTO MaintenanceLog (maintenance_log_id, timestamp, entry, section_id)
VALUES (6, TIMESTAMP '2024-10-01 08:30:00', 'treated bell peppers for aphid
infestation using neem oil', 4);
```

```
INSERT INTO MaintenanceLog (maintenance_log_id, timestamp, entry, section_id)
VALUES (7, TIMESTAMP '2024-10-03 08:30:00', 'removed strawberry runners and composted
old leaves', 5);
```

```
-- 14. Water
```

```
INSERT INTO Water (resource_usage_data_point_id, timestamp, volume_litres,
section_id)
VALUES (1, TIMESTAMP '2024-10-01 07:00:00', 45.5, 1);
```

```
INSERT INTO Water (resource_usage_data_point_id, timestamp, volume_litres,
section_id)
VALUES (2, TIMESTAMP '2024-10-01 19:00:00', 38.2, 1);
```

```
INSERT INTO Water (resource_usage_data_point_id, timestamp, volume_litres,
section_id)
VALUES (3, TIMESTAMP '2024-10-02 07:00:00', 42.0, 1);
```

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```
INSERT INTO Water (resource_usage_data_point_id, timestamp, volume_litres,
section_id)
VALUES (4, TIMESTAMP '2024-10-01 07:00:00', 25.5, 2);
```

```
INSERT INTO Water (resource_usage_data_point_id, timestamp, volume_litres,
section_id)
VALUES (5, TIMESTAMP '2024-10-01 07:00:00', 65.0, 3);
```

```
INSERT INTO Water (resource_usage_data_point_id, timestamp, volume_litres,
section_id)
VALUES (6, TIMESTAMP '2024-10-01 07:00:00', 80.5, 4);
```

```
INSERT INTO Water (resource_usage_data_point_id, timestamp, volume_litres,
section_id)
VALUES (7, TIMESTAMP '2024-10-01 07:00:00', 15.0, 5);
```

-- 15. Nutrient

```
INSERT INTO Nutrient (resource_usage_data_point_id, timestamp, nitrogen_grams,
potassium_grams, phosphorus_grams, section_id)
VALUES (1, TIMESTAMP '2024-09-15 10:00:00', 150.0, NULL, NULL, 1);
```

```
INSERT INTO Nutrient (resource_usage_data_point_id, timestamp, nitrogen_grams,
potassium_grams, phosphorus_grams, section_id)
VALUES (2, TIMESTAMP '2024-09-22 10:00:00', 120.0, NULL, 70.0, 2);
```

```
INSERT INTO Nutrient (resource_usage_data_point_id, timestamp, nitrogen_grams,
potassium_grams, phosphorus_grams, section_id)
VALUES (3, TIMESTAMP '2024-09-25 11:00:00', NULL, 120.0, 95.0, 3);
```

```
INSERT INTO Nutrient (resource_usage_data_point_id, timestamp, nitrogen_grams,
potassium_grams, phosphorus_grams, section_id)
VALUES (4, TIMESTAMP '2024-09-28 10:00:00', 200.0, 140.0, 110.0, 4);
```

```
INSERT INTO Nutrient (resource_usage_data_point_id, timestamp, nitrogen_grams,
potassium_grams, phosphorus_grams, section_id)
VALUES (5, TIMESTAMP '2024-09-30 09:00:00', NULL, NULL, 50.0, 5);
```

```
INSERT INTO Nutrient (resource_usage_data_point_id, timestamp, nitrogen_grams,
potassium_grams, phosphorus_grams, section_id)
VALUES (6, TIMESTAMP '2024-10-02 10:00:00', 160.0, 110.0, NULL, 6);
```

-- 16. Light

```
INSERT INTO Light (resource_usage_data_point_id, timestamp, intensity_lux,
duration_mins, type, section_id)
VALUES (1, TIMESTAMP '2024-10-01 12:00:00', 85000, 480, 'Natural Sunlight', 1);
```

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```
INSERT INTO Light (resource_usage_data_point_id, timestamp, intensity_lux,  
duration_mins, type, section_id)  
VALUES (2, TIMESTAMP '2024-10-01 12:00:00', 78000, 420, 'Natural Sunlight', 2);
```

```
INSERT INTO Light (resource_usage_data_point_id, timestamp, intensity_lux,  
duration_mins, type, section_id)  
VALUES (3, TIMESTAMP '2024-10-01 12:00:00', 92000, 510, 'Natural Sunlight', 3);
```

```
INSERT INTO Light (resource_usage_data_point_id, timestamp, intensity_lux,  
duration_mins, type, section_id)  
VALUES (4, TIMESTAMP '2024-10-01 20:00:00', 15000, 240, 'LED Grow Light', 5);
```

```
INSERT INTO Light (resource_usage_data_point_id, timestamp, intensity_lux,  
duration_mins, type, section_id)  
VALUES (5, TIMESTAMP '2024-10-01 12:00:00', 88000, 465, 'Natural Sunlight', 6);
```

```
INSERT INTO Light (resource_usage_data_point_id, timestamp, intensity_lux,  
duration_mins, type, section_id)  
VALUES (6, TIMESTAMP '2024-10-01 18:00:00', 25000, 360, 'LED Grow Light', 7);
```

## **AI USE ACKNOWLEDGEMENT :**

**Yes, AI (Claude Sonnet 4.5) was used to verify our work and clean up the code (fix syntax errors and formatting). We did this once we had completed milestone 3, and we did not consider the majority of the response.**

*Conversation:*

**USER:** Read the following rubric and assignment to verify that everything is valid and correct. Specifically, check syntax for Oracle SQL. Think carefully and provide all feedback and suggested improvements. <attached this document, ER diagram, rubric>

**ASSISTANT:**

I'll analyze your ER diagram and provide comprehensive feedback based on the Milestone 2 requirements. Let me examine the diagram carefully.## Comprehensive Review of Your Smart Garden ER Diagram

I've analyzed your ER diagram and the assignment requirements. Here's detailed feedback on issues to address and improvements needed:

---

## **CRITICAL ISSUES**

### **1. Primary Key Problems**

**EnvironmentalDataPoint:**

- **Issue:** Only has **timestamp** as an attribute, but the constraint note says "Each section only has a single monitor device and can only output a single datapoint at a given time"
- **Problem:** **timestamp** alone cannot be the primary key because multiple sections can have data points at the same timestamp
- **Solution:** The primary key should be **(section\_id, timestamp)** - you need to include section\_id as part of the composite key

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### Oracle DDL:

```
CREATE TABLE EnvironmentalDataPoint ( section_id INT NOT NULL, timestamp
TIMESTAMP NOT NULL, temperature NUMBER(5,2), moisture NUMBER(5,2), pH
NUMBER(4,2), PRIMARY KEY (section_id, timestamp), FOREIGN KEY (section_id)
REFERENCES Section(section_id));
```

- 

### PlantType and ToolType:

- **Issue:** Using **name** as primary key is problematic
- **Problem:** Names can be long strings, making joins inefficient. Also vulnerable to typos and updates.
- **Recommendation:** Add surrogate keys like **plant\_type\_id** and **tool\_type\_id**
- **Alternative:** If you must use **name**, at least make it VARCHAR(50) or similar with reasonable length

## 2. Location Entity Design Flaw

**Critical Issue:** **postal\_code** as sole primary key is **incorrect** for Canadian addresses

- **Problem:** A single postal code can cover multiple buildings (especially in rural areas or condos)
- **Real-world example:** V6T 1Z4 covers multiple UBC buildings
- **Solution:** Primary key should be **(postal\_code, house\_number)** or add a surrogate **location\_id**

### Better design:

```
CREATE TABLE Location ( location_id INT PRIMARY KEY, house_number VARCHAR(10) NOT
NULL, street_name VARCHAR(100) NOT NULL, city VARCHAR(50) NOT NULL, province
CHAR(2) NOT NULL, postal_code CHAR(7) NOT NULL, UNIQUE (postal_code,
house_number));
```

- 

## 3. Missing Foreign Keys in ER Diagram

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Your relationships show connections but you need to be explicit about where foreign keys live:

- **Garden** → **Location**: Garden needs `postal_code` FK (or `location_id` if redesigned)
  - **Tool** → **Garden**: Tool needs `garden_id` FK
  - **Plant** → **Section**: Plant needs `section_id` FK
  - **Section** → **Garden**: Section needs `garden_id` FK
- 

## ORACLE SQL SPECIFIC ISSUES

### 1. Data Type Considerations

#### **TIMESTAMP vs TIMESTAMP(n):**

-- Problematic - default precision varies

timestamp TIMESTAMP

-- Better - explicit precision

timestamp TIMESTAMP(0) -- second precision

-- or

timestamp TIMESTAMP(3) -- millisecond precision

#### **NUMBER vs specific numeric types:**

-- Be specific with precision/scale

temperature NUMBER(5,2) -- -999.99 to 999.99

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pH NUMBER(4,2) -- 0.00 to 99.99

volume\_litres NUMBER(10,2)

nitrogen\_grams NUMBER(8,2)

#### **VARCHAR vs VARCHAR2:**

- Oracle recommends **VARCHAR2** over VARCHAR
- Use VARCHAR2 for all variable-length strings

#### **Canadian Postal Codes:**

postal\_code CHAR(7) -- Format: "A1A 1A1" with space

-- Add CHECK constraint:

CHECK (REGEXP\_LIKE(postal\_code, '^[A-Z][0-9][A-Z] [0-9][A-Z][0-9]\$'))

#### **2. ON UPDATE CASCADE Issue**

**CRITICAL:** Oracle **does NOT support** ON UPDATE CASCADE

Per assignment FAQ #6, you should:

-- Instead of:

FOREIGN KEY (plant\_type\_name) REFERENCES PlantType(name)

ON DELETE CASCADE ON UPDATE CASCADE --  Won't work in Oracle

-- Use:

FOREIGN KEY (plant\_type\_name) REFERENCES PlantType(name)



ON DELETE CASCADE -- ✓ Supported

-- Add comment in your submission:

/\* Note: Oracle does not support ON UPDATE CASCADE.

In production, updates to referenced keys should be handled  
at the application level or through triggers. \*/

### **3. Sequence for Auto-increment**

Oracle doesn't have AUTO\_INCREMENT. Use SEQUENCES:

-- Create sequences

CREATE SEQUENCE garden\_id\_seq START WITH 1 INCREMENT BY 1;

CREATE SEQUENCE section\_id\_seq START WITH 1 INCREMENT BY 1;

CREATE SEQUENCE tool\_id\_seq START WITH 1 INCREMENT BY 1;

-- Use in inserts

INSERT INTO Garden (garden\_id, name, postal\_code)

VALUES (garden\_id\_seq.NEXTVAL, 'My Garden', 'V6T 1Z4');

---

## **FUNCTIONAL DEPENDENCIES TO IDENTIFY**

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You **MUST** have non-PK/CK functional dependencies. Here are suggestions based on your domain:

**Location Table (This is your goldmine for FDs!):**

postal\_code → city, province

postal\_code, house\_number → street\_name

This is similar to the example in the assignment FAQ!

**PlantType:**

name → requirements, desc

**ToolType:**

name → function

**EnvironmentalDataPoint (if you add derived attributes):**

temperature, moisture → soil\_condition\_category

pH → acidity\_level (e.g., "acidic", "neutral", "alkaline")

**Section (Derived attribute):**

length, width → area

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**Important:** **area** is a derived attribute (length × width). You might want to remove it OR keep it and note the FD for normalization discussion.

**Nutrient (domain constraint):**

nitrogen\_grams, phosphorus\_grams, potassium\_grams → fertilizer\_grade

You could add a **fertilizer\_grade** attribute (e.g., "10-10-10") and show the FD.

---

## NORMALIZATION CONCERNS

**Section Table - BCNF Violation:**

Section(section\_id, latitude, longitude, length, width, area, garden\_id)

FD: length, width → area

- **Problem:** **length**, **width** is not a superkey, but determines **area**
- **BCNF Violation:** Non-trivial FD where determinant is not a superkey
- **Solution:** Remove **area** (make it a computed value) OR accept this denormalization for performance and document why

**Location Table - 3NF/BCNF Violation:**

Location(postal\_code, house\_number, street\_name, city, province)

FDs:

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- (postal\_code, house\_number) → street\_name, city, province

- postal\_code → city, province

- **Problem:** Transitive dependency and partial key dependency

**Solution:** Decompose:

PostalCodeArea(postal\_code, city, province) Location(location\_id, house\_number, street\_name, postal\_code)

- 
- 

## ISA HIERARCHY IMPLEMENTATION

For your **ResourceUsageDataPoint** with Water/Nutrient/Light specialization, you have 3 options:

### Option 1: Single Table (NOT RECOMMENDED for your case)

```
CREATE TABLE ResourceUsageDataPoint (  
    resource_usage_data_point_id INT PRIMARY KEY,  
    section_id INT NOT NULL,  
    timestamp TIMESTAMP(0) NOT NULL,  
    resource_type VARCHAR2(20) NOT NULL CHECK (resource_type IN ('Water', 'Nutrient',  
'Light')),  
    -- Water attributes  
    volume_litres NUMBER(10,2),  
    -- Nutrient attributes
```

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```
nitrogen_grams NUMBER(8,2),  
  
phosphorus_grams NUMBER(8,2),  
  
potassium_grams NUMBER(8,2),  
  
-- Light attributes  
  
light_type VARCHAR2(50),  
  
duration_mins INT,  
  
intensity_lux NUMBER(10,2),  
  
FOREIGN KEY (section_id) REFERENCES Section(section_id)  
  
);
```

**Problem:** Lots of NULL values, violates normalization

**Option 2: One Table Per Subclass (RECOMMENDED)**

```
CREATE TABLE Water (  
  
    resource_usage_data_point_id INT PRIMARY KEY,  
  
    section_id INT NOT NULL,  
  
    timestamp TIMESTAMP(0) NOT NULL,  
  
    volume_litres NUMBER(10,2) NOT NULL,  
  
    FOREIGN KEY (section_id) REFERENCES Section(section_id)  
  
);
```

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```
CREATE TABLE Nutrient (  
    resource_usage_data_point_id INT PRIMARY KEY,  
    section_id INT NOT NULL,  
    timestamp TIMESTAMP(0) NOT NULL,  
    nitrogen_grams NUMBER(8,2) NOT NULL,  
    phosphorus_grams NUMBER(8,2) NOT NULL,  
    potassium_grams NUMBER(8,2) NOT NULL,  
    FOREIGN KEY (section_id) REFERENCES Section(section_id)  
);
```

```
CREATE TABLE Light (  
    resource_usage_data_point_id INT PRIMARY KEY,  
    section_id INT NOT NULL,  
    timestamp TIMESTAMP(0) NOT NULL,  
    light_type VARCHAR2(50) NOT NULL,  
    duration_mins INT NOT NULL,  
    intensity_lux NUMBER(10,2) NOT NULL,  
    FOREIGN KEY (section_id) REFERENCES Section(section_id)  
);
```

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**Note:** Remove the parent ResourceUsageDataPoint table since it has no shared attributes beyond the key.

**Option 3: Hybrid - Parent + Child Tables**

Only if you add shared attributes to ResourceUsageDataPoint (e.g., **recorded\_by**, **notes**)

---

## **ADDITIONAL DESIGN RECOMMENDATIONS**

### **1. Add Constraints:**

-- Person

```
ALTER TABLE Person ADD CONSTRAINT person_name_not_empty
```

```
    CHECK (LENGTH(TRIM(name)) > 0);
```

-- Plant coordinates should be within section

-- (Can't enforce in DDL, document this)

-- Section dimensions must be positive

```
ALTER TABLE Section ADD CONSTRAINT section_positive_dimensions
```

```
    CHECK (length > 0 AND width > 0);
```

-- Temperature reasonable ranges

```
ALTER TABLE EnvironmentalDataPoint ADD CONSTRAINT temp_range
```

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```
CHECK (temperature BETWEEN -50 AND 60); -- Celsius
```

```
-- pH range
```

```
ALTER TABLE EnvironmentalDataPoint ADD CONSTRAINT ph_range
```

```
CHECK (pH BETWEEN 0 AND 14);
```

**2. Has Access Relationship (Many-to-Many):**

```
CREATE TABLE GardenAccess (
```

```
    person_id INT NOT NULL,
```

```
    garden_id INT NOT NULL,
```

```
    access_level VARCHAR2(20), -- e.g., 'read', 'write', 'admin'
```

```
    granted_date DATE DEFAULT SYSDATE,
```

```
    PRIMARY KEY (person_id, garden_id),
```

```
    FOREIGN KEY (person_id) REFERENCES Person(person_id) ON DELETE CASCADE,
```

```
    FOREIGN KEY (garden_id) REFERENCES Garden(garden_id) ON DELETE CASCADE
```

```
);
```

**3. Missing Attributes to Consider:**

- **Garden:** owner\_id (FK to Person), created\_date
- **Plant:** planted\_date, harvest\_date, status (e.g., 'growing', 'harvested', 'dead')
- **Tool:** purchase\_date, condition, last\_maintenance\_date



- **MaintenanceLog**: performed\_by (FK to Person), type (e.g., 'watering', 'weeding', 'fertilizing')
- 

## ORACLE SQL SYNTAX CHECKLIST

### ✓ Do's:

1. Use **VARCHAR2** instead of VARCHAR
2. Use **NUMBER(p,s)** with explicit precision/scale
3. Use **CHAR(n)** only for fixed-length data (postal codes, province codes)
4. Use **TIMESTAMP(n)** with explicit precision
5. Use **SEQUENCES** for auto-increment
6. Use **CHECK** constraints for domain validation
7. End statements with semicolon (;)
8. Use **SYSDATE** for default timestamps (or SYSTIMESTAMP for more precision)

### ✗ Don'ts:

1. Don't use **ON UPDATE CASCADE** (not supported)
  2. Don't use **AUTO\_INCREMENT** (use SEQUENCE)
  3. Don't use **BOOLEAN** type (use CHAR(1) or NUMBER(1))
  4. Don't use **TEXT** type (use CLOB or VARCHAR2(4000))
  5. Don't forget to create indexes on foreign keys
- 

## INSERT STATEMENT TIPS

### Correct Date/Timestamp Format:

-- Use TO\_DATE or TO\_TIMESTAMP

```
INSERT INTO Tool (tool_id, tool_type_name, date_added, garden_id)
```

```
VALUES (1, 'Shovel', TO_DATE('2024-01-15', 'YYYY-MM-DD'), 1);
```

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```
INSERT INTO EnvironmentalDataPoint (section_id, timestamp, temperature, moisture, pH)
VALUES (1, TO_TIMESTAMP('2024-10-18 14:30:00', 'YYYY-MM-DD HH24:MI:SS'), 22.5, 65.0,
6.8);
```

**Use Sequences:**

```
INSERT INTO Garden (garden_id, name, owner_id, postal_code)
VALUES (garden_id_seq.NEXTVAL, 'Community Garden', 1, 'V6T 1Z4');
```

---

## FINAL CHECKLIST

Before submission, verify:

- ☐ Fix EnvironmentalDataPoint PK to (section\_id, timestamp)
  - ☐ Fix Location PK issue (add location\_id or composite key)
  - ☐ Add surrogate keys to PlantType and ToolType
  - ☐ Document all non-PK/CK functional dependencies
  - ☐ Show normalization steps for ALL tables
  - ☐ Use VARCHAR2 instead of VARCHAR
  - ☐ Remove ON UPDATE CASCADE clauses
  - ☐ Create sequences for auto-increment fields
  - ☐ Add reasonable CHECK constraints
  - ☐ Test all DDL in SQLFiddle or Oracle Live SQL
  - ☐ Ensure at least 5 INSERT statements per table
  - ☐ Add note about Oracle limitations in submission
-

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Would you like me to create a complete working example of the DDL for one or more tables showing best practices for Oracle?