**1. Incorporate All Ponds into the Model**

* **Rationale**: Expanding the dataset ensures the model generalizes well across all ponds, not just the three with the most data.
* **Steps**:
  1. Pull data for all ponds.
  2. Preprocess and clean the additional data to match the existing format.
  3. Merge with the current dataset.
* **Estimated Time**: 8–12 hours

**2. Add New Prediction Variables (pH, Turbidity, Ammonia)**

* **Rationale**: Expanding the prediction scope improves the model’s utility for fish farm management.
* **Steps**:
  1. Feature engineering for pH, turbidity, and ammonia.
  2. Train and validate the model on these new variables.
  3. Evaluate performance metrics (accuracy, precision, recall, F1).
* **Estimated Time**: 12–16 hours

**3. Integrate Satellite Image Data**

* **Rationale**: Historical satellite data can provide context for ponds with sparse measurements, improving model robustness.
* **Steps**:
  1. Merge this data with the primary dataset.
  2. Feature selection and importance analysis to determine the utility of satellite features.
* **Estimated Time**: 5–15 hours (includes data extraction, cleaning, and integration)

**4. Test Minimum Data Requirements for New Ponds**

* **Rationale**: Determine the threshold for usable predictions when limited data is available.
* **Steps**:
  1. Use subsets of data to simulate new ponds with varying amounts of historical data.
  2. Train and evaluate the model for different subsets to find the minimum viable dataset.
  3. Validate the use of satellite-derived features for new ponds.
* **Estimated Time**: 16–20 hours

**5. Refine Model for Generalized Prediction**

* **Rationale**: Enhance the model to use shared parameters (e.g., depth, stocking density) for better generalization to new ponds.
* **Steps**:
  1. Adjust the model to include key pond characteristics as inputs.
  2. Test transfer learning or clustering techniques (e.g., k-means).
  3. Optimize model hyperparameters for better performance.
* **Estimated Time**: 18–24 hours

**6. Validate and Finalize Model**

* **Rationale**: Ensure the model’s predictions are reliable and robust before further development (e.g., web app automation).
* **Steps**:
  1. Run final validation across all ponds and all prediction variables.
  2. Evaluate the utility of satellite data and refine features if needed.
  3. Generate visualizations and reports for stakeholders.
* **Estimated Time**: 12–16 hours

**Total Estimated Time: 70-100 hours**