

Scotsburn Dairy Production Scheduling

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Agenda

- ▶ Introduction to Scotsburn and Ice Cream Production
- ▶ Past Production Scheduling
 - ▶ Manual process
 - ▶ Based on limited, short term information
- ▶ Present Production Scheduling
 - ▶ Hierarchical Scheduling
 - ▶ New Gram Line Installation
- ▶ Future Production Scheduling
 - ▶ Where Scotsburn is headed
 - ▶ New challenges / improvement opportunities

Scotsburn Dairy Group

- ▶ Largest producer of ice cream and frozen novelties in Atlantic Canada
- ▶ Scotsburn brand distributed exclusively in Atlantic Canada
- ▶ Co-packer for major retailers with sales across Canada and worldwide
- ▶ Three production plants:
 - ▶ Saint John, NB (popsicles, fudgesicles) [60]
 - ▶ St. John's, NL (premium bars, cones, sandwiches) [170]
 - ▶ Truro, NS (ice cream tubs, premium bars) [480]



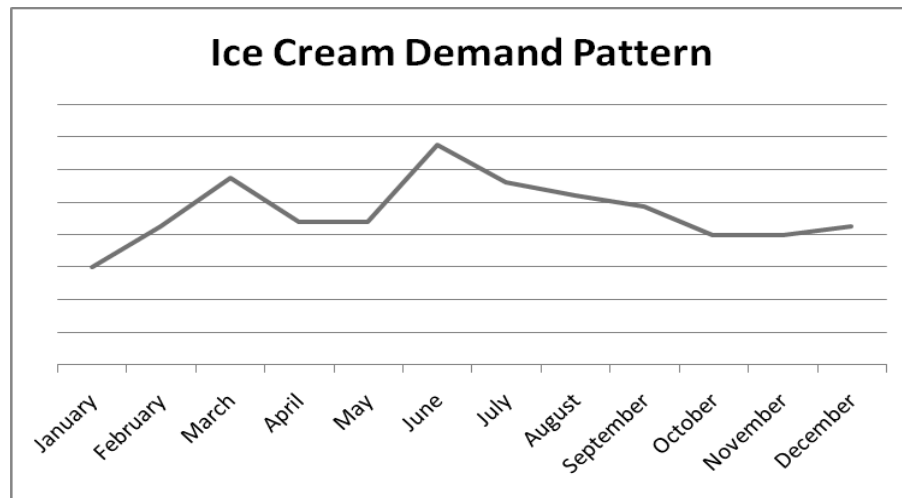
Introduction to Ice Cream

1. Make mix in batches (hold < 4 days)
 - ▶ One batch makes many different SKUs
2. Add flavours and colours
3. Freeze into ice cream (no holding)
4. Add nuts, fruit, ripples, etc.
5. Fill containers
6. Blast freeze and palletise



Ice Cream Scheduling Challenges

- ▶ Demand is seasonal and highly variable
 - ▶ Last minute promotions / weather
 - ▶ 12/52 weeks of the year, sales exceed production capacity
- ▶ Sequencing constraints due to variety of allergens
- ▶ Sharing equipment across production lines
- ▶ Product shelf life of 9 months to 2 years
- ▶ Daily wash is required due to use of dairy ingredients



Production Scheduling: Past

▶ SCOTSBURN FRENCH VANILLA YOGOURT	11.4 L
▶ SCOTSBURN VANILLA I/C	11.4 L
▶ SCOTSBURN REG FRENCH VANILLA I/C	11.4 L
▶ SCOTSBURN VANILLA I/C	473 ML
▶ SCOTSBURN O/F FRENCH VANILLA I/C	11.4 L
▶ SCOTSBURN LIGHT VANILLA I/C	1 L
▶ SCOTSBURN LIGHT VANILLA I/C	1.89 L
▶ SCOTSBURN FAT FREE FRENCH VANILLA YOG	1 L
▶ SCOTSBURN FROZEN VANILLA YOGOURT	1.89 L
▶ SCOTSBURN VANILLA ICE CREAM	4 L
▶ SCOTSBURN LACTOSE FREE VANILLA	11.4 L
▶ SCOTSBURN NSA FRENCH VANILLA	11.4 L
▶ SCOTSBURN VANILLA I/C	1 L
▶ SCOTSBURN VANILLA I/C	946 ML
▶ SCOTSBURN VANILLA I/C	1.89 L
▶ SCOTSBURN FRENCH VANILLA I/C	1.89 L
▶ SCOTSBURN FAMILY FAVORITES VANILLA	1.5 L

The Production Meeting

- ▶ Wednesday meeting to discuss production requirements for following Monday
- ▶ Which SKUs should we produce? How much of each SKU should we produce?
 - ▶ Buyer's Guide (Billing and Inventory System)

ITEM#	QTY	DESCRIPTION	BUYER'S GUIDE													
			CASES AVAIL	07-Nov 2009	14-Nov 2009	21-Nov 2009	28-Nov 2009	06-Dec 2008	13-Dec 2008	20-Dec 2008	27-Dec 2008	03-Jan 2009	10-Jan 2009	17-Jan 2009	24-Jan 2009	
2xxxx7	7	SCOTSBURN ORANGE PINEAPPLE I/C 11.4 L	202	6	8	3	9	6	8	3	1	5	4	1	5	
2xxxx9	4	SCOTSBURN GRAPENUT I/C 11.4 L	314	5	5	3	4	3	4	6	0	0	1	2	2	
2xxxx6	3	SCOTSBURN CHERRY VANILLA I/C 11.4 L	406	2	2	4	3	8	5	3	1	0	3	1	3	

- ▶ Last year's promotions included, no reviews by Sales, no new products, discontinued products still included
 - ▶ Sales memos (promotional notification, no volumes)
 - ▶ Next 2 weeks of customer orders
 - ▶ "Gut feelings" (weather, recent trends)
- ▶ Sales manager thinks we need "vanilla"



Schedule Creation

- ▶ Production manager determines line assignment and sequencing for all SKUs
 - ▶ “As Soon As Possible” first
 - ▶ No Sugar Added at the start of the week
 - ▶ 4L tubs at the start of the week
 - ▶ Yogourts at the end of the week
 - ▶ Allergens at the end of the day
 - ▶ Vanilla first, chocolate last
- ▶ Schedule is unofficially written on paper
 - ▶ Quantities based on amount of packaging on a pallet
- ▶ Not in user friendly format, not circulated, not checked for errors/omissions
- ▶ No data available from this time period

Component Procurement

- ▶ Call packaging supplier on Thursday morning for Monday
 - ▶ “Send me some vanilla tubs for Monday”
- ▶ Check this month’s inventory counts for ingredients
 - ▶ Ingredients are stocked based on gut feel each month
 - ▶ “Vanilla” flavouring
- ▶ Change schedule based on ingredient availability
 - ▶ Order additional ingredients if lacking (for later use)
- ▶ Monday morning: truck arrives with packaging
- ▶ Receiver opens doors to find out what is on truck (or not)
 - ▶ Generates a Purchase Order based on what was shipped
 - ▶ Puts vanilla packaging by production doors

Production

- ▶ Go to run vanilla - what happens next?
 - ▶ Scheduled Scotsburn 1.89L Vanilla IC
 - ▶ Packaging arrived for Scotsburn 1L Vanilla IC
 - ▶ Flavour in warehouse was for Scotsburn 1.89L French Vanilla IC
- ▶ Production calls Sales Manager to advise
- ▶ Sales Manager replies “But I wanted the 4L Vanilla IC! And by the way, we also need chocolate...”

The Need for Change

- ▶ Plant was under utilised and focused on quality, not quantity (2001)
- ▶ New business on the horizon (2003)
 - ▶ Traditional methods (paper, spreadsheets, verbal) difficult to maintain and implement
 - ▶ Planning for production and inventory becoming increasingly complex
 - ▶ Hundreds of SKUs with varying production rates, costs, demand patterns, etc.
 - ▶ More allergens and allergen restrictions
 - ▶ More complicated setups
 - ▶ Opportunities for significant cost savings

Dalhousie Industrial Engineering

- ▶ Senior design project in 2003 (Marc Oostvogels, Nick Malone)
 - ▶ Yearly overview to balance cumulative production with requirements
 - ▶ Early efforts to determine run quantities by SKU by week
 - ▶ Assumed all litres were created equal
- ▶ Senior design project in 2006 (Jennifer Pryor, Kevin Ostrovsky, Stefan Linder)
 - ▶ Focused exclusively on mix loss
 - ▶ Developed the basis for mix loss tracker

Dalhousie Industrial Engineering

- ▶ Master of Applied Science in 2007 (Andrea Friars)
 - ▶ Joint venture between Scotsburn and Dalhousie
 - ▶ Funded by Scotsburn, NSERC, MITACS
 - ▶ Supervised by Dr. Corinne MacDonald and co-supervised by Dr. Eldon Gunn
- ▶ Production Management System
 - ▶ Database for storing schedule, product formulations
 - ▶ Utilise Material Requirements Planning
 - ▶ Facilitate communication between departments
- ▶ Thesis focused on long and medium term scheduling
 - ▶ Yearly labour and storage plan (Model A)
 - ▶ Weekly production quantities by SKU (Model B)

Production Scheduling: Present

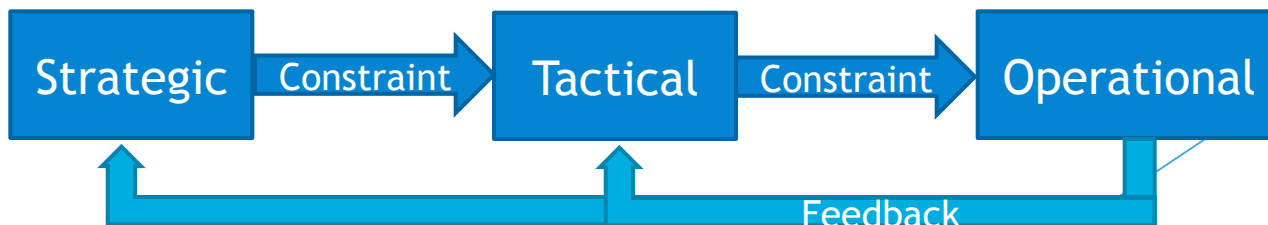
- ▶ Master's project led to full time employment as Industrial Engineer
- ▶ Work includes:
 - ▶ Long term production planning for all facilities
 - ▶ Manage utilisation of plant capacity
 - ▶ SKU assignment by branch
 - ▶ Advising on new business
 - ▶ Improving medium and short term production scheduling
 - ▶ Production and Inventory Management System
 - ▶ Continuous improvement projects

Hierarchical Production Planning

- ▶ Long Term (Strategic) 1 year
 - ▶ Labour plan / plant capacity
 - ▶ Storage requirements
 - ▶ Decision makers: Myself, Operations, Finance, Sales
- ▶ Medium Term (Tactical) 1-2 months
 - ▶ Schedule SKUs and volume by week
 - ▶ Decision maker: Production Scheduler
- ▶ Short Term (Operational) 1-2 weeks
 - ▶ Daily line assignments, product sequencing
 - ▶ Decision makers: Production Scheduler / Manager

Hierarchical Considerations

- ▶ Levels may have conflicting goals
 - ▶ Operations wants to run 1 flavour per line per day
 - ▶ Scheduler wants to keep inventory costs low
- ▶ Difficult to evaluate all stages simultaneously
 - ▶ Complex to model
 - ▶ Computationally intensive
 - ▶ Of little value
- ▶ Partition decisions into natural hierarchy
 - ▶ Simplifies problems and solutions
 - ▶ Supports managerial input

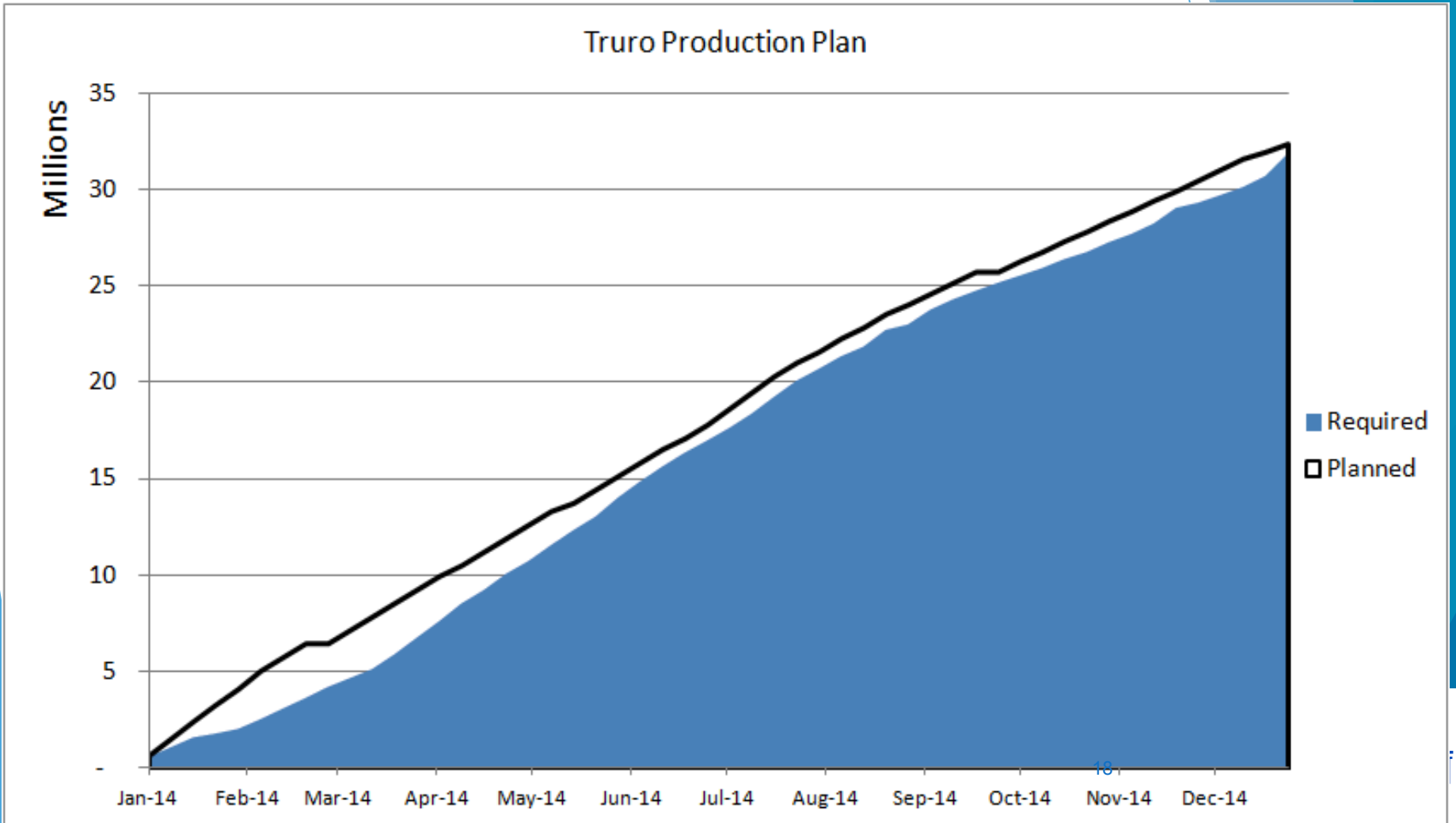


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Strategic 1 Year Plan

- ▶ Aggregate products (420) into like groups (20)
 - ▶ Similar holding costs and storage requirements
 - ▶ Similar production speeds and labour requirements
- ▶ Solve mixed integer programming problem
 - ▶ Objective: minimise holding and labour costs
 - ▶ Constraints:
 - ▶ Meet demand
 - ▶ Warehouse capacity
 - ▶ Production capacity by labour scheme
 - ▶ Output: Weekly labour scheme and storage requirements
- ▶ Re-solve the model on a rolling horizon or as needs dictate

Strategic Model A Results



Tactical 1-2 Month Plan

- ▶ Constrained by the Strategic labour scheme
- ▶ Maximise utilisation of plant capacity
- ▶ Aggregate products (420) into families (115)
 - ▶ Shared set up costs
 - ▶ Same mix and allergens
- ▶ Solve mixed integer programming problem
 - ▶ Objective: minimise holding and setup costs
 - ▶ Constraints:
 - ▶ Meet demand and safety stock levels
 - ▶ Utilise all available production capacity (Model A)
 - ▶ Output: family schedule by week (only implement 1 week)
- ▶ Used to order ingredients and packaging

Tactical Scheduling Challenges

- ▶ Advantage of families is shrinking
 - ▶ More mixes: from 30 to 60
 - ▶ More allergens: pistachio, fish oil, no more “tree nuts”
 - ▶ Smaller families = less cost saving opportunities
- ▶ Upcoming schedules are based on expected attainment
 - ▶ If a product in a family doesn't get produced, we've lost our cost savings
- ▶ Very sensitive to upcoming forecast
 - ▶ Necessitates frequent updates for improved accuracy
- ▶ Daily cleaning is like a reset button every morning

Operational Scheduling

- ▶ Objective: Sequence products to minimise changeover costs
- ▶ Input: Production quantities (Model B)
- ▶ Constrained by:
 - ▶ Labour scheme (Model A)
 - ▶ Allergen rules
 - ▶ Mix tank capacity
 - ▶ Product type (lactose-free run 1st)
 - ▶ Line restrictions
 - ▶ Shared line equipment
- ▶ Manual process for the production scheduler

Production Scheduling - Future

- ▶ Develop Model C to schedule products by line
 - ▶ Determine whether we have sufficient means to meet current requirements
 - ▶ Assess expected improvements to schedule to justify capital investments
 - ▶ Eliminate last minute changes to plan because conflicts were not caught sooner
 - ▶ Use to ensure Model B results are valid without actually committing to a schedule yet
 - ▶ Need large amounts of sequencing data!

Production Scheduling - Future

- ▶ Acquiring new plant in Lachute, QC
 - ▶ Proximity to market a bigger factor
 - ▶ How do they schedule production? What are the challenges? What do they do better than us?
- ▶ Constantly working to improve customer relationships
 - ▶ Better notification of promotions or changes in orders
 - ▶ Sales team working on real-time forecast updates
 - ▶ Consolidate similar products to utilise the same mix and components

Gram Installation Project

- ▶ Premium stick bars
- ▶ One in NL at maximum capacity
- ▶ Largest market growth potential
- ▶ Installed one in Truro in February 2014
- ▶ Strategic
 - ▶ Split up volume among both plants
 - ▶ Easy products in Truro
 - ▶ Truro line runs 30-50% faster than NL's
- ▶ Tactical
 - ▶ Time each handoff so we don't stock out
 - ▶ Customer approval required





NEW FOR 2014

Butter Maple MMadness: Creamy butter toffee flavoured ice cream with a sweet maple fudge ripple and chewy chunks of maple fudge make for magnificent, mouth-watering maple madness for your taste buds. MMMM! (SLP)

Salted Caramel Cookie Chunks: Sweet and creamy vanilla flavoured ice cream with chunks of cream filled chocolate cookie pieces and ribbons of salted caramel swirling throughout. Like your hand in the cookie jar; it'll be tough to keep from scooping more! (G,S,W)

Sprinkled Marshmallow Sundae: Ripples of butterscotch flow through mounds of marshmallow flavoured ice cream with a multitude of chocolate sprinkles to create a sundae in a scoop. (S)

ALLERGY INFORMATION: (N) CONTAINS TREE NUTS AND/OR MAY CONTAIN UNDECLARED NUT RESIDUES; (G) CONTAINS GLUTEN; (W) CONTAINS WHEAT; (P) CONTAINS PEANUTS; (E) CONTAINS EGG; (S) CONTAINS SOY PRODUCTS; (SLP) CONTAINS SULPHITES. ALL FLAVOURS CONTAIN MILK INGREDIENTS AND ARE MANUFACTURED IN A FACILITY THAT PROCESSES PRODUCTS CONTAINING PEANUTS, TREE NUTS, AND INGREDIENTS THAT CONTAIN EGGS, SOY, WHEAT AND SULPHITES.

Birthday Party: Scrumptious pound cake pieces with ribbons of blue icing and lots of rainbow candy sprinkles in yummy vanilla flavoured ice cream is the perfect way to celebrate any occasion. (W,G,E,S)

Black Raspberry Cheesecake: A premium cheesecake flavoured ice cream with sweet black raspberry fruit purée swirled throughout. **Bubble Gum:** Melt-in-your-mouth pink bubble gum pieces in blue bubble gum flavoured ice cream. (G,S,W)

Butter Pecan: The smooth creamy taste of buttery flavoured ice cream with loads of crunchy roasted pecans. (N)

Butterscotch Ripple: Sweet ribbons of butterscotch swirled throughout deliciously creamy vanilla flavoured ice cream.

Caramel Cinnamon: Caramel flavoured ice cream rippled with thick caramel and a "cinnamon" of chocolate covered caramel morsels. (S)

Cherry Vanilla: Vanilla flavoured ice cream with lots of juicy, red maraschino cherry pieces.

Chocolate: This fine blend of cocoa and sweet creamy ice cream creates a taste of chocolate perfection.

Chocolate Chip Cookie Dough: Like eating a batch of mom's soft, chewy chocolate chip cookie dough with sweet creamy ice cream, and extra chocolate chips. (G,S,W)

Chocolate Mint Chip Fudge: Green mint flavoured ice cream loaded with chocolate chips and a rich fudge ripple spun throughout. (S)

Chocolate Peanut Butter Parfait: Swirls of thick peanut butter ripple and chocolatey covered peanut butter cups nestled in rich chocolate ice cream. (P,S)

Cotton Candy: The unmistakable flavour of the country fair that everyone loves.

Death by Chocolate: Rich dark Dutch chocolate ice cream with a superb chocolate ripple scattered with chocolate brownies and dark chocolatey chunks. (E,G,S,W)

French Vanilla: A traditional recipe using whole cream, sugar, egg yolks and French vanilla flavour creates this ice cream masterpiece. (E)

Gold Mine: Swirls of caramel and chocolate ice cream with ribbons of toffee ripple.

Grapenut: A unique grapenut flavoured ice cream filled with the crunchy goodness of grapenuts for a surprisingly delicious treat. (G,W,S)

Heavenly Hash: Crunchy almond pieces with mounds of chocolate chips overflowing in a river of marshmallow and sweet chocolate ice cream for a taste of heaven. (N,S)

Hoof Prints™: Rich and creamy toffee flavoured ice cream swirled with a chocolate fudge ripple and overflowing with luscious melt in your mouth chocolatey caramel cups. (S)

Lactose Free Vanilla: Smooth and creamy lactose free vanilla flavoured ice cream for those who are lactose intolerant.

Maple Walnut: Crunchy roasted walnuts in maple flavoured ice cream. (N)

Margarita: A creamy light ice cream with citrus and lime flavoured purée blended together to give a refreshingly tangy taste of the tropics.

Melted Snowman: Winter's left behind this delicious treat of melt in your mouth vanilla flavoured ice cream, with ripples of peanut butter and a smile of real chocolate chips. Make it a triple scoop. (P,S)

Moon Mist: A mix of banana, grape and bubble gum flavoured ice cream; truly out of this world.

Mousse on the Loose: Super rich and extra creamy frozen chocolate mousse; a truly unique taste sensation.

No Sugar Added French Vanilla: Creamy and flavourful with 60% less sugar than vanilla flavoured ice cream (sweetened with maltitol and sucralose).

Orange Pineapple: Tangy chunks of citrus in orange flavoured ice cream.

Peanut Butter Fudge Crunch: A delectable peanut butter ice cream with rich fudge sauce and graham cracker crunch pieces. (P,G,S,W)

Piña Colada: A sweet exotic coconut and pineapple flavoured light ice cream with bits of chewy coconut for that true tropical taste of paradise.

Puppy Paws: A chocolate fudge ripple with chocolatey covered caramel cups in a delicious toffee flavoured ice cream. (S)

Strawberry: Delicious, ripe, red strawberries in strawberry ice cream.

Strawberry Daquiri: The perfect balance of sweet strawberries, citrus purée and lime flavour blended with creamy light ice cream to tempt your tropical taste buds.

Tiger: Tiger coloured ice cream with dark chocolate stripes.

Toffee Almond Chili: Roasted almonds and flavourful caramel bits in butter toffee flavoured ice cream. (N,S)

Udderly Divine™: Cold and creamy vanilla flavoured ice cream smothered with chewy chocolate fudge and loaded with delicious chocolatey peanut butter cups. (P,S)

Vanilla: Our classic vanilla is naturally flavoured which makes this smooth and creamy ice cream perfect with anything. The cream of the crop!

Wild Blueberry: Chunky blueberry ripple running wild in blueberry flavoured ice cream.

Frozen Yogourt With 60% Less Fat Than Ice Cream

French Vanilla: The smooth flavour of French vanilla blended with our frozen yogourt mix to create a product comparable in flavour to our French vanilla ice cream but with 60% less fat.

Fudge Brownie: Low fat vanilla flavoured frozen yogourt with swirls of chocolate fudge and chewy chocolate brownie pieces. (G,E,W,S)

Strawberry: Enjoy this unique, low fat flavour sensation; just the right level of tartness brings out all the delicious fruit flavour.

